THE

ELECTRICAL REVIEW.

VOL. LXX. MAY 24, 1912. No. 1,800.

ELECTRICAL REVIEW.

Vol. LXX.] CONTENTS: May 24, 1912. [No. 1,800.

	Page
British *v.* Foreign Plant	825
London Street Traffic Obstruction	826
Employers and Tuberculosis	826
Edison Battery Cars for London	826
"Silvertown" and the Electrical Industry (*illus.*)	827
Legal	829
Business Notes	833
Notes	843
City Notes	844
Presentation of a Bust of Lord Kelvin to the I.E.E. (*illus.*) ...	845
The Dessau-Bitterfeld Single-Phase Railway (*illus.*)	846
Stocks and Shares	856
Market Quotations	856
Share List of Electrical Companies	857
An Electric Locomotive with the Auvert-Ferrand Rectifier (*illus.*)	859
Trade Statistics of Italy	860
Proceedings of Institutions:—	
The Faraday Society	860
High-Frequency Currents	862
The Corrugation of Rails (*illus.*)	862
The Institution of Electrical Engineers	864
Correspondence:—	
On Advertising Methods	865
The Domestic Uses of Electricity	865
The E.A.C. Automatic Solenoid Starter	865
Colonial References	865
New Electrical Devices, Fittings and Plant (*illus.*)	867
Foreign and Colonial Tariffs on Electrical Goods	868
New Patents Applied For, 1912	868
Abstracts of Published Specifications	868
Contractors' Column ... Advertisement pages xxiv and xxvi	

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. *Established 1872.*

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE 1—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: Holborn 933; Central 4425 (Editorial only).

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, and has

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, 1ps. 6d.; Canada, £1 1s. 8d. ($5.30). To all other countries, £1 10s.

Binding.—Subscribers' numbers bound, including case, for 4s. each volume.

Cases.—Cloth cases for Binding, 2s. 6d. each; post free, 2s. 9d.

Foreign Agents.—New York: D. VAN NOSTRAND, 23, Murray Street. Toronto, Ont.: WM. DAWSON & SONS, LTD., Manning Chambers. Paris: BOYVEAU AND CHEVILLET, 22, Rue de la Banque. Berlin: ASHER & Co., Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1912 EDITION.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill London, E.C.

BRITISH *v.* FOREIGN PLANT.

WE have often commented upon that curious phase of British thought which is revealed in the imposition of wages clauses and similar arbitrary conditions upon manufacturers in this country, followed by the acceptance of a foreign tender. This practice is, of course, confined to municipal transactions, as no business man would dream of forcing up prices against himself by such methods; he would not hesitate to go abroad for his plant, if he were satisfied that by so doing he made a better bargain, but he certainly would not delude himself with the idea that foreign plant was the cheaper, if he himself had been the cause of its *apparent* cheapness. The practice is inspired by the desire for popularity on the part of our municipal representatives—in plain English, the need to catch the votes of the working man, who looks only on the surface and does not realise that he is thus undermining his own position; cause and effect are easily identified in this case.

But another singular tendency has sometimes been observed—and has of late attained unpleasant prominence—a tendency to purchase plant from abroad, even when the prices are level, the quality of the British product above reproach, and the guarantees as good. For this phenomenon we are at a loss to find an adequate explanation. It is, as in the former case, met with only in connection with municipal contracts, and has recently been especially manifest in the repeated purchase of Diesel engines from Continental makers.

As our readers must be aware, the manufacture of this type of engine has been carried on in this country for a period of at least 14 years, during which, according to the inventor, only minor changes have been effected in its design. The business has been taken up by numerous British engine-building firms of the highest reputation—and British engines, as a class, are unexcelled throughout the world. Many British Diesel engines have been running since the beginning of this century, and have thus given proof of their reliability and durability, while there is no appreciable difference in point of efficiency.

Why is it, then, that in so many cases lately British Corporations have gone abroad for engines of this type? We may cite the following instances:—Barking, Leek, Kingston-on-Thames, Weymouth, Epsom, Pembroke, Aldershot, Swindon and Newcastle-under-Lyme. In the case last-named, the Council rejected the recommendation of the Committee, and the order will be placed at home. We do not say that in all of these cases the British offers were the better, or that in every instance the foreign tender should have been rejected; but it is a fact that in many instances the British prices were either lower for the same speed of revolution, or about equal to the prices of the foreign engines, though the latter ran at higher speeds. It cannot be

suggested that, *ceteris paribus*, a high-speed engine is as good an investment as one that runs at a lower speed.

In some instances, the transaction was carried out after the engineer had accompanied a deputation from the corporation to visit foreign works. The fatuous futility of this procedure is obvious; what is the use of sending non-technical men to see oil-engines at work? They return as wise as they went—but, no doubt, full of enthusiasm for the courtesy of their reception, the hospitality with which they have been treated, and the amenities of the scenes they have visited. We have seen the same phenomena in connection with many other matters—such as the railless trolley, steam turbines, street lighting, &c.—and we are disposed to think that the same influences are still at work.

Let us play the game. Our British Diesels are as good as can be got anywhere for the same price and under the same conditions; why, then, should we go abroad? We earnestly appeal to engineers charged with the duty of advising on the purchase of these—and other—items of plant to see that fair play is afforded to the British manufacturer; he will do the rest.

London Street Traffic Obstruction.

Some few months ago public attention was drawn to the alleged congestion and obstruction of streets by L.C.C. cars, in a memorial presented by the Roads Improvement Association to the Board of Trade.

Tramway obstruction, real and imaginary, has provided much occasion for harmless inkspilling by the 'bus enthusiast during the past few years, but we are glad that the Highways Committee has on this occasion taken the opportunity of replying to and refuting—as regards the tramways in particular—the charges made by the Association.

We publish an abstract of the Committee's report in our "Tramway Notes," from which it will be seen that the conclusions arrived at as to the state of affairs on the roads, were the 'bus to replace the car, accord with those expressed by ourselves in our issue of March 17th, 1911.

Other aspects of the matter are also worth noting; the heavy cost of repairing road paving, of widening roads, and of carrying 42 million passengers per annum at workmen's fares—which do not cover capital charges—represents practically a subsidy to London ratepayers, for which one would think a little street car obstruction is a comparatively small price to pay, especially as it has not been shown that this can be avoided in any circumstances.

The Mansion House Station and Bank crossings provide typical instances of unavoidable traffic obstruction, in which the motor-'bus plays no small part, but apparently this aspect of the question did not interest the memorialists.

We commend to the Association the somewhat Utopian idea of the traffic circus for crowded street junctions, previously referred to in our columns. So far as we know, it has never been tried in this country, although there seems to be no reason why the experiment should not be made.

Employers and Tuberculosis.

An unsuccessful attempt was made last week to show that employers can be made responsible for that terrible scourge which has properly been designated the "white man's plague." The Junior Army and Navy Stores in their office in Regent Street have a room known as "the deposit office," where a number of clerks are employed. It measures 40 ft. by 16 ft., is 8 ft. high, and has but one window. Ventilation is provided by means of fans. A youth who entered the service of the firm in 1900 was transferred to the deposit office in 1905. He subsequently developed symptoms of phthisis, and eventually, owing to this complaint, was compelled to leave the employment in February, 1911. He brought an action for damages, alleging that it was the duty of the firm to provide reasonable accommodation, and that, as a result of his being compelled to work in an overcrowded office, he became a victim of consumption. The defence was that the plaintiff's serious condition was not brought about by the circumstances of his employment; and that even if it were so, he had voluntarily accepted those conditions. The jury found that while the conditions were injurious to health (but not to the knowledge of the employers) nevertheless they did not cause the plaintiff to suffer from phthisis, and that, in any event, the plaintiff had voluntarily undertaken the risk (if any). In the result, judgment was entered for the defendants. This is a favourable example of the application of a maxim which is frequently mentioned in cases relating to master and servant, namely, *Volenti non fit injuria*.

To render it in language more likely "to be understanded of the people," it means that, at common law, every servant impliedly accepts the risks incidental to his employment. A wireman undertakes the risk of getting an occasional shock; and if such a trade as that of wireman had been known in the year 1881, he could have recovered nothing in any Court in respect of injury so caused. In the majority of trades, however, this old common-law rule has been abrogated by various statutes, commencing with the Employers' Liability Act, 1882, and ending with the famous Compensation Act of 1906.

At the present day, the rule has practically no application to persons engaged in manual labour, or even to clerks who do not earn £250 a year. Had the poor clerk who failed in the action above-mentioned taken proceedings under the Compensation Act, he would, of course, have been met with the further defence that consumption could not be described as injury from accident arising out of, and in the course of, his employment.

Edison Battery Cars for London.

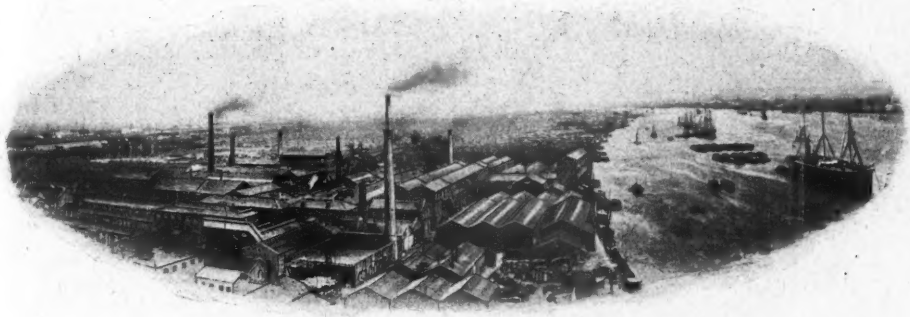
The possibilities of the electric vehicle in the large towns of Britain, and more particularly in London, have frequently been pointed out in these pages. It is, therefore, with some interest that we note a letter which appeared in the *Motor Car Journal* of May 15th, intimating that a new organisation is being formed to introduce all kinds of electric pleasure and commercial vehicles propelled by means of the Edison nickel-iron battery. We gather that the Edison people in London, who have made arrangements to represent the Anderson Electric Car Co., of Detroit, U.S.A., contemplate establishing a large depôt for showing these vehicles, also that the London central-station authorities have been approached, and—what is more to the point—are prepared to give the necessary charging facilities, in most cases during both day and night.

We read that recently an electric van, with a loaded weight of 2 tons, made a 60-mile test journey from London on a battery charge of 20 units, the cost for the whole journey being 1s. 3d. for energy.

As it cannot be denied that the electric vehicle has a considerable field of usefulness in this country, given the necessary support of the electricity supply authorities in the matter of battery charging, and sound business organisation on the part of the electric vehicle people, it is to be hoped that this latest venture will not suffer from the lack of either.

"SILVERTOWN" AND THE ELECTRICAL INDUSTRY.

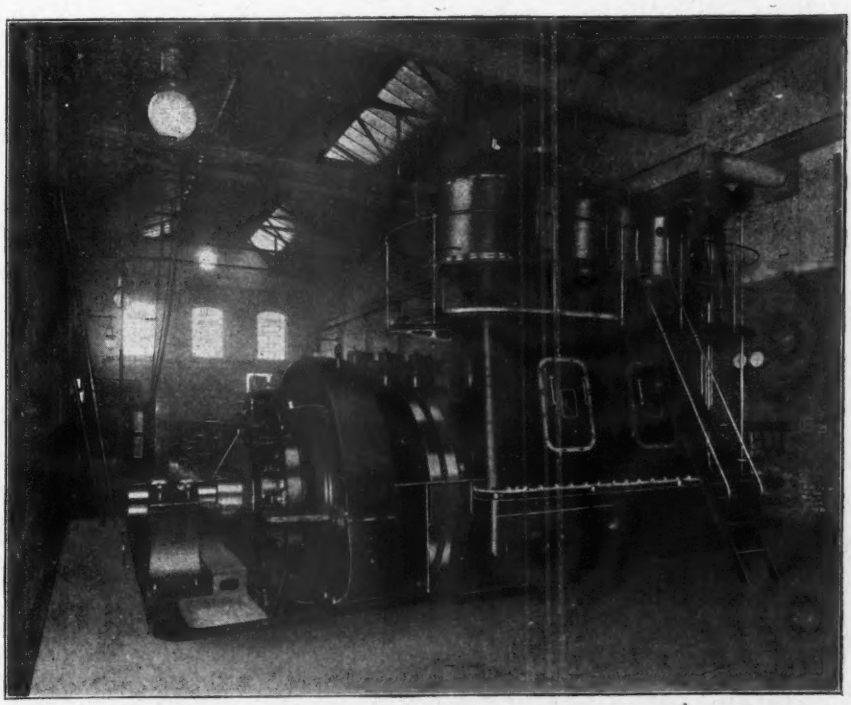
The India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., Silvertown, London, E., manufacture such a great variety of goods that one is, at times, apt to overlook the prominent position they have for so long occupied, and still hold, as electrical engineers and contractors. For this reason we believe that a brief survey of this side of the Silvertown business will be of interest to our readers.



Bird's-eye View of the Silvertown Works.

The company's works at Silvertown occupy an area of rather more than 17 acres, and are situated close to the Silvertown Station on the Great Eastern Railway. The works possess exceptional facilities in the matter of communication. On the one hand a siding from the railway enters the factory, whilst on the river front there is a wharf with a frontage of 860 ft., furnished with cranes, derricks, winches, &c., offering all the accommodation and convenience necessary in such works, where large quantities of material can be delivered by water as well as by rail.

The boiler capacity required for power and heating in works of these dimensions is necessarily considerable, and there are in use at Silvertown 36 Lancashire boilers of an aggregate evaporative power of 225,000 lb. of steam per hour, the normal weekly consumption of coal exceeding 900 tons. There are seven steam engines, driving machinery of an aggregate horse-power of 700, seven steam dynamos supplying current for light and power, of an aggregate horse-power of 3,500, and over 300 motors for driving machinery of an aggregate horse-power of nearly 5,000.



Silvertown Power Station; 1,100-h.p. Generating Set in Foreground.

At Persan (Seine et Oise) France, about 800 hands are engaged, while there are permanently employed at Silvertown from 3,500 to 4,000, a number exceeded when large contracts are on hand. The company possesses branches in Australia and New Zealand, India, South America and South Africa, and in 12 of the largest towns in the United Kingdom.

Quite a large portion of the works is devoted to the manufacture of submarine cable. In 1867 the company secured the contract for a cable to connect Key West—the southernmost point of the United States—with Havana, from the Western Union Telegraph Co., of America. This cable was the first to be made and laid by the company.

The first ship bought by the company was the s.s. *International*, which was purchased in 1870, and fitted with cable tanks and the necessary machinery, the first cable laid by her being that between the Channel Islands and the English Coast in that year. She also laid a cable between Gravelines and Bordeaux during the Franco-Prussian War.

In 1870-1871 the Silvertown Co. laid down the West India and Panama cables; in 1871 the Algiers and Marseilles cable; in 1872 the Lizard-Bilbao cable, and in 1875-1876 the West Coast of America cables, the latter totalling 1,700 nautical miles. The company also received an order for over 3,000 knots of cable to be laid on the coasts of Senegal and West Africa. Many other important submarine cables have been laid by the company, and quite recently an order has been secured from the Pacific Cable Board to supply and lay about 1,500 miles of cable between Sydney (New South Wales) and Auckland (New Zealand).

The cable vessels now owned by the Silvertown Co. are three in number, the *Silvertown* (shown at the firm's moorings in fig. 1), the *Dacia* and the *Buccaneer*, the first and last-named being fitted with the Marconi system of wireless telegraphy. The *Silvertown* is remarkable for the enormous size of her cable tanks, which will receive nearly 5,000 tons of cable, The heaviest load she has carried, when on a cable expedition, was composed of 4,880 tons of cable, 1,660 tons of coal, 110 tons of buoys, chains, grappling rope, and cable gear, and 160 tons of provisions and fresh water, amounting in all to a cargo of 6,810 tons.

The total amount of submarine cable made at Silvertown to date is approximately 60,000 nautical miles; this length refers to sheathed cable only, including that used for torpedo work, and does not take into account unarmoured core.

Silvertown rubber insulated electric light cables are known wherever this method of illumination is employed, and have acquired a high reputation for efficiency. In addition to cables for telegraphy, telephony, lighting and power, the company manufacture bell wires, telephone cords and flexibles, India-rubber and gutta-percha insulated wires, shot-firing wires, motor-car leads, &c.

The Silvertown company was one of the first to manufacture Gramme machines in England. One of the earliest undertakings of the electric light department was the equipment of the works with an extensive electric light installation, which, when erected in 1882, was the largest private plant in the United Kingdom. Since that time many alterations and extensions have been made to the plant, the many small belt-driven dynamos having been replaced by larger direct-coupled medium-speed sets, and the isolated steam engines throughout the factory by electric motors. At the present time, in addition to two 250-H.P. marine type engines, each driving by ropes a continuous-current dynamo, the machinery put down includes one 1,100-H.P. engine and dynamo (shown in the foreground in fig. 2), and four 500-H.P. sets, working at 150 lb. pressure. The system of distribution is two-wire at 200 volts, supplying current to the equivalent of 14,000 8-C.P. incandescent lamps for lighting, and over 300 motors (already referred to) of from 1 to 150 H.P., driving the planes, drills, lathes, cable machinery, calenders, mixing mills, masticators, pumps, cranes, and capstans, &c., in the factory.

The manufacture of dynamos and motors is an important feature of the work executed in the electric light department, and a considerable business is carried on in supplying British and foreign Governments, and private firms, with these and other apparatus necessary in electric lighting and in the transmission of power—such as balancers, boosters, motor-generators, and rotary converters. Amongst others, we may instance the continuous-current plant delivered to the War Office and Admiralty and many British Corporations.

A great variety of instruments is made, including much special apparatus used in various departments of the factory. The submarine department, together with the cable ships connected therewith, employs a large number of instruments for experimental and research work, as well as for the testing of submarine cables at all stages of the manufacture and laying. The general business of the instrument department at Silvertown includes the manufacture of electrical apparatus and intruments for the Post Office, War Office and Admiralty, railways, cable and other companies, Colonial and foreign Governments, &c., and, in fact, Silvertown instruments are well known over the whole world. Among the numerous instruments devised at the works, are the Silvertown portable testing sets, which have been largely used for many years by telegraph, telephone and electric light engineers; the Silvertown water-level apparatus for electrically indicating or recording, at any required distance, the change of level of the water in tanks, reservoirs, rivers, &c.; the various high-class testing keys of Mr. Rymer-Jones, now universally used; the conductometer of Mr. Rollo Appleyard, and the ingenious two-tone vibrating transmitter of Mr. E. Raymond-Barker for conductive and inductive signalling.

Due to the great extension of telegraphy in recent years, there has resulted an increased adoption of various systems—such as duplex, quadruplex and automatic telegraphy—designed to augment the message-carrying capacity of the lines, and thus cope with the heavier traffic. In addition, the introduction of central-battery and secondary-cell working, together with improved switchboard methods, has contributed largely to the same end by providing quicker and more efficient methods of working. The construction of the various instruments and switchboards required for these improved systems forms an important portion of the work turned out by the instrument department. The heavier work demanded in the construction of switchboards for electric light and power installations is carried out elsewhere in the works.

Another branch of the work of the instrument department is the manufacture of condensers of various kinds for wireless telegraphy, and for telephone, telegraph, and submarine cable work.

The manufacture of batteries for telegraphic and other purposes is an important industry, and at Silvertown no fewer than five shops are entirely occupied therewith. One shop deals with the preparation of carbon and manganese; another is employed in the pressing and shaping of carbon plates; a third is fitted with the necessary retorts and furnaces for the firing of carbon plates and electric light rods; a fourth is furnished with hydraulic presses for the forming of Leclanché battery blocks; while in the fifth shop the various parts of the battery are fitted together.

Besides Daniell, bichromate, Minotto, Grove, and Bunsen cells in all forms, the company makes a speciality of Leclanché cells. The last-mentioned type of battery was originally introduced into this country nearly 50 years ago by the Silvertown company.

The supply of material for telegraph and telephone overhead lines also forms a section of the company's electrical business, and large quantities of this class of goods have been supplied to railway and telegraph companies in China, South America, South Africa, India, &c.

A new train-lighting equipment was recently introduced by the company, and was fully described in our issue of December 1st last. It has been designed on the lines suggested by actual practical experience, special attention being given to ensuring a thoroughly reliable equipment that is easy to install, and cheap to maintain.

A very varied assortment of manufactures is produced in what is known as the india-rubber department, whose workshops are the chief, as well as the most extensive, in the factory. Rubber-insulating gloves form the principal product of this department for electrical work. All Silvertown rubber gloves are thoroughly tested, either at 5,000 or 10,000 volts, and each glove is sold with a label certifying this test.

The company make a feature also of special red quality insulating mats for switchboard platforms, india-rubber tiling for the front of switchboards, &c., and they are, of course, large makers of battery syringes, jointers' waterproof tents, valves, sheet, washers, engine packing and hose.

Ebonite, one of the manufactures in which the Silvertown company have obtained some celebrity, is, as many of our readers are aware, produced by hardening india-rubber through prolonging and intensifying the curing or vulcanising process. The use of ebonite in the electrical trade is largely increasing. Cells, fork separators, sheet separators, rod and channelling insulators, bobbins, handles, switch caps, plates for condensers, and other articles are, wholly or in part, made of ebonite.

Among the Silvertown company's other manufactures are numerous insulating tapes and jointing materials, &c.

Educational Notes.—IMPERIAL COLLEGE OF SCIENCE.—Mr. Herbert Wright dealt with diseases of rubber plants in his fifth and last lecture at the Imperial College of Science. He complained that few people realised the gravity of the position; only one mycologist was provided for 220,000 acres of Hevea in Ceylon, and two for 400,000 acres in Malaya. He regarded the paucity of scientific officers on rubber estates as one of the gravest errors of our administration, and appealed to private companies and Government to tackle the problem now while diseases and pests were in their infancy.

In the tenth of the special series of lectures on rubber, Dr. Schidrowitz said it appeared to be the fact that the supplies of high-grade gutta-percha were gradually failing, and it did not seem to be practicable—on account of the slowness of growth and small yield of the trees—to plant gutta in the same way as rubber. He thought it extremely probable that in the future, not perhaps immediately, but within the next 15 or 20 years, the falling-off in the high-grade gutta supplies would force submarine cable makers seriously to consider the use of rubber, and he personally believed that the difficulties attending its use at present, were by no means insuperable.

The last of the special series of lectures was delivered by Dr. Schidrowitz, and dealt with the chemical and physical properties of vulcanised rubber, and the methods of applying mechanical and chemical tests to vulcanised rubber.

LEGAL.

OSRAM LAMP WORKS, LTD., *v.* THE "Z" ELECTRIC LAMP MANUFACTURING CO., LTD.

(Continued from page 790.)

MR. TERRELL having concluded his speech for the defence, evidence was then called.

MR. WILLIAM PAKENHAM said the defendant company commenced in June, 1907, as a syndicate formed to acquire the patents under which they were operating; he meant the predecessors of the defendant company. They acquired patents and processes for making lamps from Dr. Hollefreun & Co. and Zerning & Sander; they were the patents under which defendants were now working.

WITNESS, examined, said: In 1905 or 1906 there was an electrical exhibition, and there was no metal-filament lamp on the market then with the exception, he thought, of the osmium. In 1906 two lamps were imported from Germany, and there were no other tungsten lamps on the market made in this country before that date. Osram lamps were advertised in this country about 1907, but not made here until, he thought, the last two years. The "Z" Co. commenced right away in 1908, manufacturing high-voltage lamps, and were the only people doing so.

MR. FROST: What do you mean by high voltage?—Lamps of 200 volts and upwards in contradistinction to 110 and 100-volt lamps.

What was the power of the high-voltage lamps put on the market by them in 1908?—Somewhere about 60 C.P.

WITNESS, continuing, said they required what was known as black metal; it was an amorphous form of tungsten, and the only form of tungsten which could be used in practice in their process. Hollefreun and Zerning worked out the method of preparing the tungsten; these were the people in Germany from whom they bought the patent. The soft and hard-paste processes were absolutely different.

Questioned as to the hard-paste process, WITNESS said it consisted in taking a metal in a very fine powder. We take a binding material, which contains so much of this nitric radical and enough oxygen to burn itself out—the very thing that you are instructed to take out in this specification—we mix these together, and then we subject them to a very high pressure. If you mix material like our binding material with a very finely divided metal and attempt to put that under a high pressure, you will get no filament squirted. The binding material separates out under the press, the more fluid stuff comes out first, and you get a scaffolding in your die; the consequence is, beyond the mixing, you have to put in the calendering operation. Calendering includes mixing, but it is quite a separate process. You have to mix your metal and binding material into a thoroughly homogeneous mass; you then squirt it. It is put into dies and squeezed under enormous pressure. Our pressure is something like 25 tons to the square inch. The pressure in the soft-paste process is merely pounds. That makes the filament, and it then passes through the baking stage, when a very large proportion of the carbon is removed. The baking in the hard-paste process is not in any way comparable with the carbonising in the soft-paste process. The baking is done under a vacuum, because you want to take away as much of the carbon as you can.

Do you find in the specification of the plaintiffs any directions to do this?—No, you are not told to do that; you are told to carbonise.

His LORDSHIP: According to you, as a practical man, seeing the direction in the plaintiffs' specification that you are to carbonise, which of the two, the hard paste or the soft paste, would you take?—There is no question about it; this is a soft-paste process. He mentions coagulable binders, and he mentions a material which you could not use with a hard paste as one of his binders.

His LORDSHIP: You say it would lead you to the soft paste?—There can be no question about it to a lamp maker.

MR. FROST: Is there anything in the specification hostile to a hard-paste process?—Yes, he directs you to use a solution of cellulose and chloride of zinc which you cannot use in the hard-paste process. You cannot get rid of your chloride of zinc and your filament will never dry.

His LORDSHIP: For the hard paste, what solution do you use? I do not want you to tell any trade secrets, but perhaps it is not a secret?—It is not a secret in this Court, I think. We use a solution of collodion in amyl-acetate which is a vaporisable solution quite different to these coagulable solutions.

MR. FROST: What are the materials for making the binder?—Collodion and amyl-acetate and a small proportion of castor oil.

What, as a lamp maker, do you understand by the term sintering, which is the next stage?—Sintering is the operation of shrinking together to a solid coherent filament.

Will you shortly summarise the practical points which have been worked out and made your process a successful one, and the modern lamp a successful lamp?—The success is due to the particular form of metal used and required. Then there is the binder. The question with the binder is the quantity and the nature of the binder. Then there is the calendering, and then there is the high-pressure squirting, baking in the vacuum, and the sintering operation.

MR. FROST: Dealing shortly with the second specification sued on, 18,622, of 1906, reading that specification as a practical lamp-maker, what would you understand that you were directed to?—There is no question, this is a decarbonising process used on the filament.

We will go to the weights—the third patent. When the defendants bought their process, were the weights being used then by the people who sold the process to them?—Yes.

His LORDSHIP: I do not quite follow this.

MR. FROST: Defendants bought their patent under which they work, and the weight process was part and parcel of it. (To witness): What is the effect of putting the weights on first of all, as the plaintiffs contend they do, during the sintering operation?—Apparently that was a very old idea to put weights on filaments, at all events carbon filaments, and I think it was simply transferred to this metal-filament industry without any question. On the sizes of filaments on which we were working in the old days, there was no difficulty in using the weight, but when you come to thick filaments or very thin filaments, the weight is not an advantage. Using the weight on the fine filament during the sintering stage you get an extremely V-shaped filament.

Why?—In a high-voltage lamp you have to put 10 filaments in the lamp, and the filament is drawn down with a very narrow base. With the thin filaments, the slightest knock to the lamp starts the filaments vibrating, and if they are V-shaped, as I described, up at the top of the V the filament is not stretched apart wide enough to prevent the legs touching round the hook and they run together, and once they begin to run they run on till they get to the point where they break.

Could you by the defendants' process make a filament containing 5 to 10 per cent. of carbon?—Using our metal and our binding material without any added carbon, it would be absolutely impossible for us to get a filament which, at the baking stage, would contain 5 per cent. of carbon.

Cross-examined by MR. ASTBURY, WITNESS said his experience of lamp making was confined to the "Z" lamp. They made all thicknesses of filament substantially from '15 of an ampere up to five amperes.

MR. ASTBURY: You say that the first lamp was made subsequently to June, 1907, and I suppose the first filaments were made subsequently, too?—The first filaments were made as soon as we could get the plant working after June, 1907.

Do you know anything about the quantity of tungsten-filament lamps that were sold in this country in the latter half of 1906 and the first part of 1907?—No; but not many, I should think.

If Dr. Oberlander, in June, 1907, made tungsten-filament lamps at Hammersmith under this patent on which we are suing—that is, the Just and Hanaman steam and hydrogen patent—do you know anything about it? Were they sold?—Unless they were I should not know.

If some of those lamps were handed to Dr. Liebmann, and burnt successfully for two years, that you would not know?—No, I should not know.

Will you look at No. 1,535 of 1898, the Welsbach patent. Was it one of your points that you used an extremely small amount of binder?—It is not merely a question of quantity.

Do you know whether the osmium filaments were in fact all of them made of what you call a hard paste?—This does not refer to a hard-paste process at all.

We say it does?—But this is impregnating or coating—this has nothing to do with squirting.

What do you suggest is the purpose of your carbonising, which is not in the ordinary known form of carbonising?—Our carbonising is to get rid of the bulk of our binding material.

With regard to the question of the amorphous metal. You do not know, do you, to what extent that was known prior to 1904?—Personally I do not know that it was not known. I know that it began to be obtainable in 1908-9.

Questioned with regard to the weights, WITNESS said they began stopping the use of hooks in December, 1910, on the thick filaments, and it was a gradual process of giving up the hooks until about the summer of 1911.

You say that it is not an advantage to use a weight during the sintering in either the thick or the thin ones?—Quite so.

Do you happen to know that every Osram lamp which has ever been made in this country has always had a weight on during sintering?—I could not say anything about that.

MR. JAMES SWINBURNE then gave evidence as to the development of the carbon filament.

MR. TERRELL: What was the usual method of forming filaments in 1904?—The universal manner practically was the soft-paste or Swan process for making carbon filaments.

When you got the idea that you wanted to make a metal filament out of high-resistance metals, what was the difficulty?—The first difficulty was to realise that such a thing was possible at all. I found with tungsten and molybdenum that I could squirt by mixing them with gum tragacanth as a binder. I found that I could not squirt these metals through small holes, and I came to the conclusion that there was no hope at all of making practical lamps. The idea of making wire lamps of such brittle metals that would be of any commercial value at all seemed absurd, and I gave it up as hopeless. Then I heard of Welsbach, but even then I concluded that he would not succeed in making a lamp on the lines he was following. The success of the tungsten lamp is due not to any invention. Once Welsbach had pointed out that you had a possible line of working by making his osmium lamp, then everyone knew that you could try the same sort of thing with high-resistance metals. The first thing was to get the right metal. That was done by taking the Delepine process.

Asked about hard paste, WITNESS said if they were going to get a metal filament that had a lot of metal to begin with, they must have hard paste, because they must have as little binder as possible, otherwise they got the particles of metal far apart, separated by a lot of carbon. After the calendering came the squirting. One was apt to suppose the machinery was all ready, waiting for use, but all that machinery has been designed and worked out since. First of all it involved getting fine dies. As a matter of fact fine dies were used for drawing very

fine wire in wire works. They could have been got if lamp makers had known where to get them, but these hydraulic machines had to be worked out. They had to get the hydraulic machines which would allow them to squirt the thick hard paste. Then they must work out the details of handling these fine filaments and then baking them. Moissan showed about 1889 that tungsten was a very infusible metal. It was known that tungsten was reduced by hydrogen, and that at a high temperature tungsten would oxidise readily, and would decompose.

MR. TERRELL questioned WITNESS on the specifications, and continued:—After the baking process which has been described in this case such as is practised by the defendants, what is the condition of the carbon in that filament?—I think it is most probable that the carbon is entirely in the form of carbide.

MR. TERRELL: You see in the literature, and even in these specifications, it is frequently referred to as being in a state of carbide?—Yes.

Reading this specification, what do you understand by the terms "in an atmosphere of steam and hydrogen"?—I should say it was an atmosphere of steam diluted with hydrogen, but it has been assumed that because the apparatus that is now used is not an apparatus that can conveniently be kept at a temperature at which you could have steam, the patentee had somehow determined to use that particular apparatus and had meant not to use steam at all, but traces of vapour.

With regard to the issue of infringement, in what respects does what the defendants do differ from what the plaintiffs specify?—Leaving out whether the patent is limited to the use of hard paste or soft paste—then as regards the third process of equalising, it is obvious that it is not used. Coming to the second process of decarbonising with water, while it is quite true that at the beginning of our sintering process, when you begin to burn the filament up, and, indeed, right through, there must be some combination of carbon with traces of water in the jar, that is an entirely immaterial and accidental result, against which all reasonable precautions are taken. What happens really, is that the defendants are sintering in a reducing atmosphere. If you want to sinter a filament you must either do it in a complete vacuum, which is expensive, or you must take what was quite common practice in lamp making—a reducing or protecting atmosphere. What the defendants do is to take a protecting atmosphere of hydrogen and use that. Looking at it as a matter of substance, we say the defendants are sintering in a protecting gas and nothing else.

With regard to patent No. 2, will you tell my Lord what the invention is there?—The invention, as I, as a lamp maker, understand it, consists of changing from the steam and hydrogen, which had been modified in the meantime to hydrogen with a very little trace of moisture, to hydrogen with no moisture, and with nitrogen put in the place of moisture to remove the carbon; and, as an alternative, instead of putting nitrogen in you may use some ammonia.

At what stage of the operation do you consider that that is specified?—This would be a decarbonising process done after baking.

The defendants put phospham on to their stem, and then they make it hot. So that in the decomposition of phospham in these lamps you will have ammonia and moisture?—No doubt.

With respect to the third patent, in your experience as a manufacturer of lamps, do you know that hooks have been used?—I never used them myself in the earlier days, but I know the literature, and I know the sort of result you would get. I can tell you that incandescent carbon filaments are most delicate of all during the process of carbonisation, and they are, next, most delicate in the process of equalising before they get hot, so that the most delicate time of the existence of a carbon filament is during the baking, where weights have been disclaimed as being put on, and the next most delicate part is during what they call flashing, where weights also are shown as put on.

Was it a common practice to put weights on?—I do not know that of my own knowledge. Using weights on carbon filaments came in after I stopped making carbon lamps.

Do you yourself see any advantage in putting the weights on during the sintering process instead of in a subsequent process?—This is really a question of economy of manufacture. If the weights worked equally well, of course it would obviously be better to do it in one process.

Cross-examined by MR. ASTBURY: Witness agreed there were certain chemical actions of gases on bodies at certain temperatures which must operate if they were brought together at those temperatures. He also agreed that where a novel invention of difficulty started, as the years went on, the steps which were taken to effectuate the best results were always being improved upon. Witness was then taken through the 1904 patent specification.

You never heard or knew of a lamp being made by either the Lodyguine or the oxychloride process prior to 1904, the date of our patent, did you?—No, I don't think so.

In one of the documents there is the precise process used in the defendants' works, both as to the hardness of the paste, the minute amount of binder, the calendering and everything else absolutely set out and described?—It differs only in degree.

Collodion, unless it is used with acetic acid, cannot make a soft paste?—I should not think so.

You have formed a view at present that the man who published the document had his mind on soft paste?—Yes.

We do not accept that, but let me assume that it is right. A man at that date who read this document and assumed that it meant soft paste, and who made a lamp filament out of soft paste, could then carbonise it by the ordinary process then known or disclosed in these documents. And if he then put that filament into an atmosphere of steam and hydrogen he would decarbonise it by oxidation. When he had done that he would have a filament which, in your view, would be one which could be improved by flashing?—Yes.

Will you look at Claim 1—he would then have produced an incandescing body for incandescent lamps consisting of tungsten, and which would be manufactured substantially as and in the manner described in the document?—I agree.

Will you now look at the second claim—supposing that he stopped at the decarbonising, and did not flash it after decarbonising. Claim 2 says: "Process for the manufacture of incandescing bodies in accordance with Claim 1." Now, I will ask you to assume from me that "in accordance with Claim 1" means repeating the language of Claim 1. That would be—"Process for manufacturing incandescing bodies," and then reading the actual words of Claim 1, "for incandescent electric lamps consisting of tungsten." If he stopped at the decarbonising and did not make it uniform, would he not then have put into practice a process for making an incandescing body for an incandescent lamp consisting of tungsten having these features, or characterised by the fact that tungsten had been mixed with an organic binding medium, that it had been formed and carbonised and the carbon removed chemically?—If your interpretation of Claim 1 is what his Lordship adopts, that would be so.

There is no prior document which discloses or suggests the building up and squirting of a tungsten filament in accordance with the osmium process and decarbonising it in steam and hydrogen, is there?—No.

Assume that your view is right that if you make it with a soft paste, you can improve it by flashing in the sense of uniformity?—Yes.

Assume that if you make it of hard paste, that is a process which is not necessary, because it is quite uniform after decarbonising?—I will assume so from you, although you must understand that I disagree entirely with that particular step.

You disagree with what?—That you can from a hard paste, by following this specification, make a filament that does not require equalising.

We know it is done every day in the defendants' works?—No, that is the whole point at issue.

His LORDSHIP: Mr. Swinburne says that it is done, but that it is done by sintering.

MR. ASTBURY: I am assuming that a man does this with hard paste, and he does it in Voelker's way. If he does that, we have it from Mr. Pakenham and from you that it is indistinguishable in every way from the process adopted by the defendants?—No, I think Mr. Pakenham put a great many other things.

What difference is there?—Our calendering is different, because we use different speeds. It is only a difference of degree.

How do you know that Voelker does not use different speeds?—Because he does not say so. He may do, but I cannot assume that he does.

His LORDSHIP: Voelker does not use the expression "calendering." All he says is, "Rolled for about an hour between hard and polished steel rolls." Nothing is said about the speed of the rolls.

The Court adjourned at this stage. On resuming, MR. ASTBURY asked whether they might have some of defendants' thicker filaments to enable them to carry out a certain experiment. They now knew that they were all made in the same way.

His LORDSHIP: That must be without prejudice to any objection you may make as to the thicker filaments.

MR. TERRELL agreed to supply the filaments.

MR. ASTBURY (further cross-examining): Please look at Welsbach, 1,535; it says:—"The function of the protective atmosphere is to oxidise the carbon of the filaments without oxidising the osmium or obtaining a deposit of carbon on the filament." The function of the hydrogen is to allow the other part of the gas which can oxidise the carbon to do that, the protective hydrogen protecting the osmium from oxidation at the same time?—Yes.

"Free oxygen must not be present, and in fact the atmosphere shall be such as will reduce any oxides of osmium that may be present. In such a reducing atmosphere the filament can without danger be raised to a temperature which consolidates the osmium." That means sintering of osmium?—No, I do not think it does, because you get some sort of consolidation in these filaments long before sintering temperature, which has been referred to by a witness as the coherer effect.

"And forms it into a useful coherent filament"—that is, a metal filament of osmium?—Yes; there were useful coherent filaments of tungsten which were not sintered, therefore not nearly as good as the present filaments, but they were commercial.

Do you know how many millions of osmium lamps had been made in 1904?—No; I had not seen any, as far as I know.

The Nernst lamp was also a known manufactured lamp at that date?—Yes.

The Nernst lamp filament was made of a hard paste, mixed in a Pfleiderer machine?—Yes.

Was there a single metal filament prior to 1904 that had ever been made with a soft paste?—Not to my knowledge. I can only refer you to the osmium patent.

Can you point out one single advantage that in 1904 anybody could possibly think they would get by using a soft paste if they wanted to get a metal filament?—I do not think you would get an advantage, and doubt whether anyone who had hard paste in his mind in 1904 would think soft paste better; but you had the earlier specification of Welsbach dealing with soft paste, and you have a specific instruction here to use soft paste. If you take an intelligent lampmaker, I say that he would not learn anything from this specification; but if you are going to take a man who knows little enough to take all this specification very seriously, then he would make a soft-paste filament.

Supposing that this specification was handed to Dr. Oberlander in 1897 without any directions at all, and that he took it, produced a hard paste, squirted it through a die with a screw pressure, manufactured his paste in the ordinary way, that he had non-metallic-filament lamps made before that, that he then carbonised and decarbonised, and found it did not require any further flashing, mounted that into lamps, and that two of those lamps burnt in Dr. Liebmann's laboratory for two years.

Mr. Terrell said he objected to such questions at this stage of the proceedings, and that Dr. Oberlander had not been called.

Mr. Astbury said his friends had called a lot of evidence, of which no hint had been given. Plaintiffs could have called any number of lamp makers, but there was no point for them to be called upon,

Mr. Terrell: My friend says I did not put to his witness the difference between hard and soft paste. I put it that this was a soft paste patent, and upon that he did nothing.

Mr. Astbury: I am told that it is not pleaded. I do not think the words hard or soft paste appear once.

His Lordship: I am perfectly aware of that. My impression at present is that the patentee has not told the ordinary workman what process he is to adopt. If the patentee knew he ought to convert the mixture into that shiny sheet which is then rolled up and pressed through a die, he ought to have said so.

Mr. Astbury: Have you ever since the date of this patent heard of a filament being sintered in a jacketed vessel?—No.

Did you ever hear of a Lodyguine filament being made?—Not before this case.

And there is, in fact, no direction in Lodyguine how to get rid of the fillet from the inside of a filament?—I do not remember any.

Prior to the patent of 1904 that we are suing on, there never had been any suggestion of any publication had there, that you should make a tungsten filament by the building-up process of Welsbach?—Not that I remember.

It is a fact that since 1904 the built-up tungsten filament has become the most successful filament in the world?—Yes.

Counsel then took witness through the various experiments that had been made with the view of comparing and ascertaining the difference between plaintiffs' and defendants' processes.

The phospham is put there for the purpose of removing the carbon?—The phospham is put there because they say it makes a lamp better—a better vacuum.

You believe that it does, in fact, remove carbon?—Yes, to some extent.

You know no purpose for which it can be there other than that?—No.

We have, therefore, got it that in the defendants' last process they do in fact eliminate carbon in an atmosphere of ammonia from a filament which has been built up of powdered metal with the addition of organic binding materials?—Yes.

You did find cyanogen as the result of this operation of the defendants?—No, I found cyanogen in other cases, from which I infer that it probably takes place in the defendants'.

His Lordship: You do not deny that the process of the defendants may produce some cyanogen?—No, I think it does.

Mr. Astbury: Some very strange documents have been put to you as anticipating this second patent. Is there a single suggestion in any of this literature of decarbonising a tungsten built-up filament with nitrogen and hydrogen, or ammonia, in lieu of doing it by an oxidising process?—I remember none.

Then we come to the prior grant. I want to ask you one question—that is, Specification 15,510, of 1907. My friend put a question to you which I do not agree with. You will see they are practically saying that you can decarbonise with less than 1 per cent. of oxygen with water vapour?—Yes.

Then it says:—"This process is of practical value when means are arranged to remove the last perceptible traces of oxygen—containing gases and vapours from the gas mixture. Traces of oxygen containing gases, still remain in the mixture on account of the inadequacy of the plant, and these traces will have the desired effect." Does that mean anything more than this—that if you use a plant with which you are going to try and get rid of all traces of oxygen, it may very well be, and is likely to be, that the plant will not be quite sufficient to do that very difficult work?—That is what it means.

But that you might still have traces of oxygen there, although you did not want them?—Yes.

His Lordship: He says something more than "may." I think he says that you will get it.—Yes, he must have it for his patent.

In reply to questions about the use of weights, Witness said: You will find in one of the earlier specifications that Edison carbonised carbon filaments freely in a vessel with a weight on them, and my point is during that time the carbon went through a much tenderer state than it ever does in any other part of the carbon manufacture. It was therefore old to filament makers to hang a weight on at the tenderest part of the life of the filament.

It matters enormously however what the relative proportion of that tenderness to its strength is?—Yes.

If you are going to weight the metallic filament after sintering, it involves a separate heating up, a separate set of jars, a separate current, &c.?—Yes.

Mr. Charles Fred. Topham, general manager of Mr. Stearn's works, said he had occupied that position ever since he had been manufacturing lamps—that was about 1882. Mr. Stearn used to manufacture lamps at Kew under the name of the Zurich Incandescence Lamp Co. In the year 1898, Mr. Stearn started his present factory at Kew, and still carried on business there under the name of the Stearn Electric Lamp Co. In that year Mr. Stearn commenced the manufacture of metal-filament lamps. Witness said the practice in those factories with regard to the weights was that they always used the weights when it was desired to make a straight filament of carbon. It was common knowledge to them. Witness recollected going with Mr. Stearn to Berlin in the year 1906, and certain notes were made by Mr. Stearn, which witness saw. It was the "Z" Co.'s factory which they went to, and there they saw metal-filament lamps made, and investigated the manufacture of same. Witness brought some powder from Berlin. It was given to them as metal powder, and also a binder. The powder was a mixture of tungsten and zirconium; the binder was made of gun-cotton dissolved in amyl-acetate.

Witness, asked to describe what he did, said he added about 10 per cent. of the binder to the powder and then rolled it with a pair of photograph rollers—steel rollers; the process was known as calendering. He then took the paste and placed it in a gun-metal cylinder and forced it through a die into filaments. After that, he dried the filaments at about 60° to 100° C. for the purpose of drying off the amyl-acetate. They were then put into a porcelain tube on an iron tray, and raised in a vacuum to a temperature of about 800°, with a very small quantity of hydrogen passing through. They were then allowed to cool down, taken out and put into forceps and placed in the ordinary glass vessel used for flashing carbon filaments. A small weight was then put on in order to keep the filaments perfectly straight, as they were liable to cockle and twist about. The filaments were very delicate, and it was very seldom witness could get a filament strong enough to bear a weight, although he sometimes succeeded. He always tried to succeed, and it was a long time before he found out how he failed. A lot of trouble was caused by the porcelain tubes, as they cracked, and the temperature had to be kept very low. He always put on the weights whenever possible. The weights were brought into use from the very commencement, and they were used to the present day. The weight was put on in the sintering process. If the filament was not strong enough to bear the weight before sintering, it was put on immediately afterwards.

Had you been doing the same thing with carbon lamps before that time?—Yes, whenever narrow or straight filaments were required for making tube lamps. I had to hold a filament perfectly straight while the hydro-carbon was being deposited on it.

What weight did you have on?—A piece of platinum about 16 mils in diameter with a length of, I should think, about ¾ of an inch.

Witness first used pure tungsten very shortly after that; it was made of zinc and tungstic acid on the Delepine process. He first used tungsten about April 25th, 1906.

Cross-examined by Mr. Colefax: After his visit to Germany, they commenced to put into practice the process they saw there. The putting on of the weight was done in Mr. Stearn's laboratory, but the subsequent process was carried out in the factory. It was about a month or six weeks after their return that they found out what the metal powder consisted of through Dr. Feilman, a chemist. The powder was analysed, because it decomposed in the lamp and zirconium came off and left the tungsten behind, in burning in the lamp after being evacuated. He was not prepared to say that any metal-filament lamps were sold in 1906. When those made by the Zurich Co. were first sold they were called Leuconium. They found it was very seldom they could use the weight beforehand during sintering. In separating them they could tell by the handling of the filaments whether they were tender.

About the dies, can you tell us the diameter of the filament?—I commenced by using a die five mils in diameter.

Re-examined by Mr. Terrell: What was done with the lamps, were they run in the factory?—They were run at Westminster.

His Lordship: You are certain they were run at the factory?—Quite certain.

Between April and September, 1906?—Yes, because we had the lamps blacken so badly.

Mr. A. C. Hyde, a practical lampmaker, said he was actually engaged in lamp making in the years 1901 to 1904 with the Edison-Swan Co. at their factory at Ponder's End. While there, he was the technical expert to the company, principally in connection with the lamp department. At that time they were making carbon lamps. The high-voltage carbon lamps had very fine carbon filaments. Previously to his commencing work on this particular form of lamp, great difficulty was experienced in getting uniformity in a filament. When he took the matter in hand, he found, what he had previously known to some extent, that filaments must be carbonised under strain to be made uniform. He found the greatest strain he could possibly employ was the best. The filaments were subjected first of all to a preliminary baking with the weights applied, at a temperature of about 600° or 700° C. in a large crucible through which gases passed. During that period these filaments passed through a stage in which they were plastic and very weak. After this preliminary baking to 600° or 700° C., the top portion we lifted off and put into a carbon trough which formed part of the electric furnace. The whole thing that carried the weights was lifted off, and put into a carbon trough. A great many were put in in one operation—about 50 or 60. The carbon trough formed the core of an electric furnace, the whole of the core was surrounded by some non-conducting material. When all was ready an electric current was passed through the core, and the temperature rose to 2,500° or 3,000° C. During the electric furnacing the carbon became again plastic, so it was necessary to keep the weights on the whole time, or the filament would cockle up. After the electric furnace operation, which took three or four hours, the furnace was cooled down and the filaments were cut away from the rod and were then ready for use. In the first furnacing

up to 600° or 700°, ordinary coal gas was passed through. In the second furnacing no gas at all, but simply hydro-carbon oil sprinkled on so as to burn up the air.

Cross-examined by MR. COLEFAX: Was the current passing through the filaments when they were in this furnace?—Yes, it was.

Was the temperature between 2,000° and 3,000°? Was the current passing through the filaments heating them up to that temperature?—Yes.

During that stage there is, in fact, no contraction taking place?—No. In the first furnacing you get about 40 per cent. contraction. When you carbonise any thread, it shrinks, but if you put a strain on it, it does not shrink so much. If you had no weight on you would have got a shrinking of 50 per cent. in the filament; with the weights you got 40 per cent.

With regard to the second temperature, there is no contraction?—Yes, there is about a further 5 per cent. With the weight on it was 5 per cent., without the weight on it was about 10 to 15.

MR. GEORGE LUEDECKE gave evidence through an interpreter, Dr. Otto Hehner. Witness said he was the manager of the Brimsdown Lamp Works, Ponder's End, who carried on the business of metallic-filament lamp makers. He was also works manager and technical adviser. Witness had been engaged in the practical manufacture of lamps since 1883, and had worked with Siemens and others. Witness also manufactured lamps at Augsburg as George Luedecke & Co., and from 1906 under the name of the Wolfram Lamp Co. Witness came to this country to take up his present position in 1909. He also had experience in Germany for a considerable time with Just and Hanaman. His firm had bought all patents which were possessed by Just and Hanaman at that time concerning Germany as regards tungsten filaments. Witness had read the specification of Just and Hanaman that was the subject of this action.

MR. TERRELL: In your view as a lamp-maker, would this teach you that a soft or a hard paste was to be used, or both?—I understand from this specification that a soft paste is to be used.

Speaking of your own experience, when did you first become acquainted at all with a hard-paste process?—In August, 1908, we came to Buda-Pesth, and Hanaman showed us a hard-paste process with gum tragacanth and tungsten powder.

Is that the first you heard of a hard-paste process?—No, I had heard before that.

Did you at any time, and where, work the oxychloride process of Just and Hannaman?—We bought the patents in March, 1906, and I think we had the necessary apparatus in June or July of the same year, and we worked with the oxychloride process until 1908.

How many filaments did you make by the oxychloride process?—Up to 50,000 filaments daily.

Was that work carried out under the German Specification 154,262?—I do not remember the number of the German process, and I rather think the hexachloride and the oxychloride process are the same.

WITNESS: We prepared the hexachloride by passing chlorine over tungstic oxide. In a long furnace there was a tube 1 m. 50 cm. long in which the tungstic oxide was placed. At one side the chlorine entered, and from the other the chloride or oxychloride issued, and was condensed in a receiver. Having prepared the hexachloride, then came the process of the preparation of the filaments. In a bell jar holding 150 cb. cm., very thin carbon filaments were placed. In the bottom of the bell from 1 to 2 grammes of the hexachloride were placed. A flame was placed beneath the bell, in order to evaporate the chloride. When that had been done a current was passed through the thin carbon filaments, and at the same time a little hydrogen was passed through it. Upon the carbon filament thus a layer of metallic tungsten was precipitated. When there was sufficient the amperemeter connected with the filaments showed when we had to stop. Afterwards the filaments were taken out of this apparatus, and were placed in a second vessel—this was called the decarbonising process. The filaments were then placed in series, current was sent through the filaments thus placed, and at the same time hydrogen was passed through. First, the carbon combined with the tungsten, produced tungsten carbide, and at the same moment was decomposed, and the pure Wolfram remained behind. The tungsten filaments were hollow, and during the removal of the carbon the filaments were weighted by small weights.

Were those filaments made up into lamps and sold?—Certainly they were.

Cross-examined by MR. COLEFAX: In the process described, was not a mixture of steam with reducing gases used to get rid of the carbon?—At first we had thick filaments containing much carbon, and we had to pass the hydrogen through the water. Later on, when we were capable of making very thin filaments, it not only was not necessary to pass it through the water, but, on the contrary, we had to dry hydrogen by passing it through sulphuric acid.

Did you acquire a licence under the German Just and Hanaman patent corresponding to the specification I am handing you now?—I cannot say exactly. I can only say we acquired all German patents, and if there is a German one corresponding to this, then we did buy it.

When did you commence to manufacture a filament using oxychloride of tungsten?—In July, 1906. We started with five girls and we finished off with 70 people working by day and 70 at night, all employed in making filaments by the oxychloride process.

At that date did you use steam and hydrogen?—I passed the hydrogen through a bottle containing water, so that the hydrogen became but very little moist.

When you abandoned it, you were using these very fine filaments that you have spoken of?—We found it out by accident. One day the water had been sucked out of the bottle, and I came to the workman who pointed out that on that day the manufacture went much better, and since that time we have given up using it. Then we went in the contrary direction and dried the hydrogen very much—we passed it over phosphorus pentoxide and sulphuric acid. When we used water vapour, the filament had light spots and burnt through, and afterwards when we had dry hydrogen, this no longer was the case. We made 50,000 filaments daily, placed them in lamps and sold the lamps.

Do you know the process that is being used there to-day?—Not the oxychloride process, but a paste process.

In 1904, for a built-up metal-filament the only process you knew of was the osmium process?—Yes.

As you used the term soft paste and said that this specification 23,899 of 1904, describes to you a soft-paste process, what is it in the specification that points to a soft-paste process?—I know that Just and Hanaman did not know a hard-paste process, but only used the ordinary soft collodion which was used for the preparation of carbon filaments.

Will you tell us what the collodion was that you used—what was its consistency?—I used a 15 per cent. collodion, and the differencies consisted in this, that I tried for months to work by this patent, and I never succeeded.

Have you ever had experience of the manufacture of tungsten filaments from collodial tungsten, made without a binding agent?—Yes.

MR. HORATIO BALLANTYNE said he had never been a lamp maker. For the last four years he had acted for the defendant company. At the date of the first patent sued on in this case, the only manner known to him in which filaments were made, was that of squirting a soft paste. He never heard of the hard-paste process until he met Voelker.

MR. TERRELL: You have heard Mr. Swinburne's evidence. Do you agree that carbon volatilises if a carbon filament is over run?—Yes. The carbon comes off and is deposited on the walls of the bulb.

Supposing a tungsten carbon filament is run up near to the melting point of tungsten, what happens to the carbon?—The carbon volatilises out. Whether it comes out as carbon *solus*, or whether it is in combination as carbide I cannot say, but that it does come out non-chemically I am satisfied.

Coming back to the specification, have you read it with a view to find out whether it was a soft-paste or a hard-paste process, or applicable to both?—Yes; as I understand it, it is applicable to soft paste only.

Have you ever seen in your life an artificial silk process, which you could describe as a hard-paste process?—No, and I have never heard of one either.

MR. TERRELL was asking witness further questions when MR. ASTBURY said:—Hardly one of these things has been suggested to our witnesses. We have not a conception that this was the sort of case alleged against us when our case was closed.

His LORDSHIP: This is all in the particulars. The sufficiency of the description is a matter, the onus of which lies on the plaintiffs.

MR. TERRELL (to WITNESS): Have you made filaments by the soft-paste method?—Yes, and leaving out for the moment the question of the cuprammonia method, one can make filaments by using the soft-paste process with carbon or chloride of zinc solution in cellulose. Then I have tried the hard-paste process, using chloride of zinc cellulose, and I must say that that has proved a difficulty. I have made a number of experiments, and I have not been able to get a filament by using the hard-paste process with chloride of zinc cellulose.

MR. ASTBURY: May I say that again has not been suggested to us. There has been no suggestion to any of our witnesses that there is any difficulty with chloride of zinc in a hard paste. When I sat down after I had finished my evidence I had no conception that many of these points which have been taken were even suggested or hinted at.

MR. TERRELL: What about the particulars of objections.

MR. ASTBURY: They are not in those particulars.

His LORDSHIP: Surely you must have known that one of the objections relied on was that there are not sufficient description of the invention. The difficulty I feel about it is this: Assuming the osmium process to be a hard-paste process, of which I am not quite sure, but if the patentee knew that a process similar to that used by the defendants was the way of making filaments he ought to have told you so; and if he did not know it, then he has made no invention.

MR. ASTBURY: Your Lordship seems to think that there is some difficulty about this soft-paste process. You can make it just as well by the soft-paste as you can with the other.

His LORDSHIP: That is not so. What I feel is that he has not told you what you are to do.

MR. ASTBURY: I am going to remove that difficulty. I am going to ask your Lordship to let me put certain witnesses into the box.

His LORDSHIP: I know you are. But I do not understand it to be their case that only the hard paste will work. The point of insufficiency is that he has not told the public with sufficient detail how to do it

After further discussion, his LORDSHIP said: There will be an application on Mr. Astbury's part for leave to adduce further evidence. That I understand, and on that I shall have carefully to consider whether that leave ought to be given or not.

In further examination of witness, MR. TERRELL asked: Now, as to what the defendants do. First of all, do the defendants

use the hard-paste process?—They do. They bake the filaments under reduced pressure in a gentle stream of hydrogen, in which process the nitro-cellulose is decomposed and dispersed, and much of the oil is distilled over and a small residue of carbon amounting to about ·4 to ·8 per cent. is left.

In what condition is the carbon present, in your opinion? It is present in the form of carbide. It is very difficult to get any experimental evidence, one way or the other, as to the condition in which it exists. I may say that what appeals to me in coming to that conclusion is the strength of the thread. The quantity of carbon is so extremely small that I can hardly imagine its existing merely as a kind of mortar joining up the bricks. We know that a cementation process goes on and that tungsten is capable of combining with carbon at temperatures far below the fusion point. In these filaments during baking, we have this extremely finely divided tungsten in contact with extremely finely divided carbon, and it seems to me that the natural result will be that, at the high temperature, this transfusion of carbon with tungsten metal will occur.

When the defendants do their sintering, what, in your opinion, happens?—When the current is switched on, the temperature goes up extremely rapidly, and incipient fusion of the filament substance takes place. Whilst in this semi-fused condition, the particles are drawn together. The carbon, in my opinion, is an important element in that action, because, as we know, carbide of tungsten has a lower melting point than tungsten itself. As I picture the operation, the carbide fuses, the filament draws together and at the same time the carbon is expelled from the filament, leaving substantially pure tungsten, which has a very high melting point.

In your view is the carbon removed from the tungsten chemically?—Substantially not.

MR. TERRELL asked Witness, with regard to the second patent, what experiments he had tried with regard to the action of hydrogen and nitrogen. WITNESS said he found no difference whatever in the result, whether he used hydrogen alone or hydrogen plus 3 per cent. of nitrogen—the carbon was all substantially removed in half a second.

MR. TERRELL: The suggestion of my friend is that the ammonia means that the ammonia is to be a substitute for the nitrogen and the hydrogen. If that is so, did you try it in ammonia?—I tried the sintered filaments in ammonia, that is to say, treating the filaments in bulbs with ammonia instead of phospham. In the case of the phospham lamps made up with these filaments, there was no blackening, but in the case of those made up with ammonia, there was blackening.

(To be concluded.)

MR. JUSTICE WARRINGTON delivered his reserved judgment in this case on Tuesday, May 21st, deciding in the plaintiffs' favour as to the first claim, and for the defendants as to the other two. Notices of cross-appeals were given. The judgment will be reported in our next issue.

FERGUSON SUPERHEATERS, LTD., *v.* ASKERN COAL AND IRON CO., LTD.

THIS action, which was brought to restrain an alleged infringement by the defendants, of Askern, near Doncaster, of the plaintiffs' patent for steam superheaters No. 25,611 of 1905, granted to Charles Melville Ferguson, came before Mr. Justice Neville in the Chancery Division on Tuesday.

Mr. Walter, K.C., and Mr. Gray were counsel for the plaintiffs, and Mr. Bousfield, K.C., and Mr. Colefax represented the defendants.

In opening the case, MR. WALTER said that the usual defences were raised, but he did not think that any question would arise as to non-infringement, as the defendants had done the plaintiffs the honour to copy their invention exactly. The defence, he understood, would really be anticipation and want of subject matter.

After Counsel's opening speech, Mr Dugald Clerk gave evidence, and was cross-examined by Mr. Bousfield. Mr. Walter then announced that the parties had come to terms. The defendants had consented to pay an agreed sum for damages and costs, and the plaintiffs would grant them a licence to use the invention. His Lordship made an order in the terms agreed.

BUSINESS NOTES.

Russia.—The St. Petersburg *Journal* reports that the Government intends to make amendments to some of the existing import duties, and amongst others, that on incandescent lamps will be increased. When the present tariff came into force in 1906, there was no import of metal-filament lamps, nor, of course, were they manufactured in Russia. Since then some metal-filament lamp works have been started, but they have not been very successful, and have had to fall back on the manufacture of carbon-filament lamps, as the insufficient protection afforded them by the tariff did not allow them to compete with the lamps of this kind imported. The duty fixed in 1906 was 7½ copecks per lamp, but it is now proposed to increase this figure up to 90 roubles the pood. Lamps will, of course, be much dearer to the consumer; carbon-filament lamps will be charged the same duty, but there is, of course, practically no import of them.

Condensing Plant Contracts.—Among the orders recently booked by the MIRRLEES WATSON CO., LTD., of Glasgow, are the following:—

Surface Condensing Plants.—Leeds Corporation Electricity Department, condenser having 24,800 sq. ft. cooling surface; Frederick Smith & Co., Salford Wire Works, per the B.T.-H. Co., Ltd.; Midland Junction Railways, Australia; Devonport Corporation, per Jas. Howden & Co., Ltd.; Lanarkshire Steel Co.; Sanquhar and Kirkconnell Collieries, per D. Selby Bigge & Co.

Condensing Plant of the "Mirrlees-Leblanc" Type.—Weardale Steel, Coal and Coke Co., per D. Selby Bigge & Co.; the Fife Coal Co.; Falkirk Corporation, per Jas. Howden & Co., Ltd.; Maatschappij "De Laval," Amsterdam, for two cargo steamers; Ipswich Corporation, per Willans & Robinson.

Low-Level Jet Plant.—Rossington Colliery, per the B.T.-H. Co., Ltd.

Barometric Jet Plant.—Hornsey U.D.C.; McMurtrie, Guiler & Co., U.S.A.

In addition to the above there are a number of special air pumps for Sweden, South Africa, Borough of Hampstead, Greenock, &c.

Dissolutions and Liquidations.—S. BOTTONE & SON, LTD.—A meeting of creditors is called for May 29th at Temple Chambers, London, E.C. The company is winding up voluntarily. Mr. H. A. G. Lewis, liquidator.

SWITCHGEAR CO., LTD.—A meeting is called for June 14th, at 109, Colmore Row, Birmingham, to hear an account of the winding up from the liquidator, Mr. H. Keeling.

ROWLAND & HULTON, LTD. (in voluntary liquidation), 109, Great Eastern Street, London, E.C., electrical engineers and contractors.—A meeting of creditors is called for May 22nd at 119, Finsbury Pavement, London, E.C. Mr. G. E. Corfield, liquidator. Mr. R. P. Hulton informs us that he has purchased from the liquidator of Rowland & Hulton, Ltd., the stock and goodwill of their business, and that he will carry on the business under the style of R. P. Hulton & Co., at 109, Great Eastern Street, E.C., as electrical engineers and contractors.

CHINNERY SIGNS (1909), LTD.—Creditors must send particulars of their debts, &c., by June 5th, to the liquidator, Mr. H. J. Sheldrake, 12, Duke Street, Chelmsford.

THE HELPTOPHONE CO., LTD.—A meeting is called for June 19th, to hear an account of the winding up from the liquidator, Mr. R. Evans Smith.

THE SUNBEAM LAMP CO., LTD.—A meeting of creditors is called for Monday, June 3rd, at 11 o'clock a.m., at the offices of Messrs. Watson Burton & Corder, Pilgrim House, Newcastle-upon-Tyne. Liquidator, Mr. T. Wallace, 42, Mosley Street, Newcastle-on-Tyne. The resolution for voluntary liquidation was passed on May 14th, Mr. J. T. Merz presiding.

Electric Heating.—THE BASTIAN ELECTRIC HEATING SYNDICATE, LTD., inform us that their agents, Messrs. Wheeler and Sons, of Victoria Gardens, Notting Hill Gate, W., have secured the order to heat and ventilate St. Michael's Church, Cornhill, E.C., and that Bastian electric heaters will be used throughout. Messrs. Drake & Gorham, Ltd., have recently fitted Bastian electric heaters in several dining halls and other rooms in the Holborn Restaurant, and amongst other important orders recently booked is one for 70 Bastian heaters for use on H.M. battleships, and in several dockyards.

Consular Notes.—URUGUAY.—A report of the machine-testing station of the Agricultural College at Monte Video gives certain details of the comparative running costs of various types of motors in Uruguay, and particularly in Monte Video. From these details it appears that electrical power in Monte Video is relatively cheap, and that it is particularly profitable for small industrial purposes. A much extended use of the Diesel engine is anticipated, particularly as for some little time now the importation of these engines for agricultural purposes has been allowed free of duty. It appears that the first motor plough was made only last year in Uruguay, and now there are more than 50 in use.

India.—The German Consul in Bombay reports that the installation of electric and gas lighting, and of other public works, is being rapidly extended not only in the largest towns, but also in the outlying districts. In Bombay, for instance, the new dwellings and offices are nearly all fitted with electric light and electric fans, and some also with electric lifts. Electric lamps are not separately specified in the Indian statistics, but it appears from the German export returns that the exports of German lamps to India were valued at 54,000 marks, 165,000 marks, and 110,000 marks, in 1908, 1909, and 1910. Hardly less important than lighting is the demand in the bungalows for electric fans. Where electric power is available, there is in every room an electric fan attached to the ceiling, and generally there are also small portable lamps. There is also a large demand for electric machinery and power plant; not the least important part of this demand is for the textile factories in Bombay, and it may be anticipated that in a few years, most, if not all, of the larger spinning and weaving mills, at least, will be run by electric power.

Russia.—The Austrian Consul in Rostov reports that, since the coming into force of the arrangement between the Schuckert Werke and the firm Siemens & Halske, the leading *rôles* in the trade in that district, in electro-technical goods, have been played by Siemens & Halske and the Allgemeine Elektricitäts Gesellschaft. The former has secured important installation works, including the extension of electric control of the Novorossisk Cement Works, the erection of the electric station at Nowotscherkask, and the extension of the municipal electric light works at Nachitschewan. No new electric tramways were constructed in 1910, but projects for such tramways at Stawropol and Tagaurog were prepared. In the

trade in arc lamps, in which a Saxony firm was formerly actively engaged, the firm Siemens & Halske, and the Allgemeine Elektricitäts Gesellschaft, have eliminated outside competition. In telephone apparatus, bells, &c., a St. Petersburg firm have taken the largest orders, and after it a Hungarian firm. As regards public telephones, the firm Siemens & Halske have succeeded in squeezing out competition, and the same has occurred in the trade in telegraph materials. A Swedish firm, through its St. Petersburg house, actively competes in the trade in house telephones. Carbon-filament lamps are supplied chiefly by a Berlin syndicate, a Dutch house, and a Warsaw firm; incandescent lamps of Hungarian origin are also to be found on the market. Metal-filament lamps have become increasingly popular in recent years, and in 1910 the demand in the Rostov district was very large. German firms are prepared for the supply of insulating tubes for electric installations.

Spain.—The Austrian Consul at Barcelona reports that the imports of dynamos, electric motors, induction coils, resisters, transformers, switchboards, &c., in 1910, amounted in value to 11,400,000 pesetas. There is a very good demand for this class of goods, and a large opportunity for sales. Especially for goods weighing not more than 400 kgs. each, and for small electrical installations, is there an increasing demand, and the imports of these goods increased from 2,700,000 pesetas in 1908, to 3,000,000 in 1909, and 4,700,000 in 1910. Germany rules the Spanish market, but France, Switzerland, Great Britain, Belgium and the United States also take an important share. Insulated cables and wires for the transmission of electricity were imported in 1910 to the value of 1,300,000 pesetas, as against 1,900,000 pesetas in the previous year. The demand for these wires, 1 cm. in diameter, is falling off, the cause being partly the increasing home production and partly the existing conditions. Germany takes the most important share of the trade. Telegraph apparatus and telephones, electric meters, &c., were imported in 1910 to the value of 1,500,000 pesetas. The importation is on the increase, and is chiefly from Germany, France, Sweden, Belgium and Great Britain. The opportunities for trade in these lines are very great. Electric arc lamps were imported to a value of 408,039 pesetas, chiefly from Germany; carbons for these lamps accounted for 130,000 pesetas, and the demand for them is on the increase. Electric incandescent lamps, mounted, are in strong demand and the demand is increasing. In 1908 the imports amounted to 900,000 pesetas, but by 1910 they had increased to 2,300,000 pesetas. Although a factory for the production of these lamps has been started in Spain, producing at cheap prices, it will be seen that the demand for foreign lamps is still large. Germany is still the largest participator, but France, Austria and Great Britain also supply certain quantities. The price for Spanish lamps is 50 pesetas per 100, and for foreign 90 pesetas per 100, payment in 90 days. The imports of fixed steam engines and gas motors in 1910 amounted to 2,900,000 pesetas, but they have fallen off considerably during the last three years. In 1908 they amounted to 4,200,000 pesetas, and in 1909 to 1,600,000 pesetas. Great Britain, France and Germany are the largest suppliers. The trade in cylindrical steam boilers has also declined over the same period, and in 1910 amounted to only 1,300,000 pesetas. The trade in tubular boilers and gas generators amounted to 2,800,000 pesetas in 1910, as against 1,900,000 in 1909, and the trade in hydraulic motors has also fallen off; as regards the former, Germany, Belgium and France are the largest suppliers, and as regards the latter Germany, France, Switzerland and Sweden.

Turkey.—The Austrian Consul at Salonica reports that the trade in electro-technical apparatus has greatly increased in recent years, as the telephone installations and the other electrical undertakings of the town have been extended considerably. The trade in Salonica is now chiefly confined to small articles for household use. The imports amounted to 30,000 fr. in 1910, chiefly from Austria, Germany and Belgium. The trade in larger goods for the electric stations, the railways and the other large undertakings with their own electrical plant, is chiefly carried on direct with firms in Austria, Germany and Belgium. Firms interested should note that if they hope to increase their trade in these larger goods it is necessary that they should be adequately represented on the spot.

Brazilian Trade and Finance.—It is of more than passing interest to note in the Presidential address of Hermes da Fonseca the continued progress of Brazil. For the financial year 1911 the foreign trade of the country amounted to more than £119 millions, representing an increase approaching £9 millions as compared with 1910, whilst the customs receipts for the same year exceeded those for 1910 by 16,328 contos. The total receipts from all sources, including credit operations, amounted to 139,948 contos of reis gold, and 424,581 contos paper, the expenditure totalling 89,088 contos gold and 511,874 contos paper. In respect of the revenue proper there was a gold surplus over expenditure of 33,266 contos, and a net deficit of 34,069 contos paper. The external debt of the country stands at nearly £83 millions, together with a sum of 300 millions in francs. It is important to observe also that the gold passing into the Conversion Fund in 1911 reached almost £8¼ millions, and the withdrawals over £3¾ millions. The milreis in gold is equal to 26·93 pence at par, and the paper in currency milreis is fixed at 16d. per 1,000 reis, or one milreis, a conto being the equivalent of 1,000 milreis.

The Brazilian Conversion Law of 1906, it may be added, fixed the value of the currency milreis at 15d. (since increased comparatively recently by a law containing other alterations to 16d.), and anyone may change at the Conversion Caisse, or the Caixa de Conversao, their notes for gold, or *vice versa*, at the fixed rate. The notes issued by the Conversion Caisse are legal tender, and their acceptance is obligatory for all contracts and payments, except in cases in which payment is decreed, undertaken, or contracted to be effected in gold, and must be realised as at present by the legal rate of 27d. per milreis, in notes of the Conversion Office at their gold value as established by law. That the Conversion Law of 1906 has given a much-needed stability to Brazilian currency is undoubted, its primary objects being stability and the accumulation of a gold reserve for the eventual conversion of the unconvertible paper in circulation and its supersession by a currency convertible or exchangeable on presentation.

It is easy to see that (prior to the fixation of the rate) a non-guaranteed currency is likely to favour the home producer when the exchange rate of the monetary unit is low, inasmuch as he pays his wages and other forms of trading expense in the depreciated standard, and ships his produce for payment in gold. *Per contra* the importer buys for payment in gold, and sells for payment in depreciated paper. Similarly with British tramway and other undertakings. They receive in such circumstances their revenue in paper of changing value, which, to a considerable extent, has to be converted into gold for the purpose of paying dividends and interests, machinery for equipment purposes, and other home requirements. A non-guaranteed currency with internal widely fluctuating exchange always acts as a detrimental clog upon the wheels of the machinery of real industry.

Re-Establishment of the International Aluminium Syndicate.—It is announced from Paris that the several months of negotiations have now resulted in the resuscitation of the International Aluminium Syndicate, which collapsed as far back as 1908. The combination, which has been brought into immediate operation, is composed of the producing works in France, Switzerland, Great Britain, the United States, and Canada, although the sales organisation of each individual constituent remains the same as hitherto. The capacity of production of the works has been estimated, and the division of the world's business is to be effected *pro rata* to the actual sales which have already been carried out by individual producers within a particular period. It is intended to fix prices after mutual discussion. The trade for the present year has already been substantially concluded. Nevertheless the basis price has been arranged at £70 per ton, but sales for next year are not to be undertaken for the present. It will be remembered that the former syndicate collapsed, owing to the price policy pursued in the direction of forcing up quotations to an exceptionally high level, thus stimulating the promotion of new undertakings which kept outside the combination, and which led to exceedingly keen competition and falls in prices, and eventually to the dissolution of the syndicate. The new syndicate, which was formed in Paris on April 29th, is said to have been constituted for a number of years, although its operations will scarcely commence before January 1st, 1913, seeing that nearly all business has already been transacted for the current year. It appears from a statement made by the chairman of the Neuhausen Aluminium Industry Co. on April 30th, that a few signatures to the agreement were then still lacking, although there is no doubt that they will be obtained. The details of the agreement are to be kept secret, as a result of an arrangement made at the Paris meeting. The conditions under which the Neuhausen company has joined the syndicate might have been better, but it was thought advisable to accept them in the interest of final peace, and in order not to allow the scheme to be abandoned. It is, however, considered to be a favourable circumstance that the syndicate has been revived, as the consumption of aluminium has enormously increased during the obstinate trade contest which has proceeded for several years past. The hope is expressed that the syndicate will render useful services, although it is admitted that the greatest caution will have to be exercised in the matter of price policy.

Catalogues and Lists.—The Armorduct Manufacturing Co., Ltd., Farringdon Avenue, London, E.C.—16 page illustrated list (No. C. 1,137) of "Glob-o-lite" illuminated signs. The principle of construction of these signs is described and a number of night effects illustrations show the signs used effectively in advertising service for hotel, restaurant, and shop exteriors. The "Glob-o-lite" signs included in the list are for single lamp and reflector use, and for special reproductions, art metal shop window advertisements, and interchangeable letter signs for cinematograph and music halls, illuminated facias, etc. In the construction of the signs, between two plates of perforated sheet metal are placed moulded crystal glass balls, having a flange around their diameter. The back and front hemisphere of the glass sphere project through the perforation in the back and front plate respectively, and the flange of the ball, when the two sheets are bolted together, is tightly gripped between them, holding the ball securely in position.

The British Thomson-Houston Co., Ltd., Rugby.—Price list No. 348 (eight pages) giving illustrated particulars and prices of B.T.-H. fan motors for bracket, desk and other service, also C.C. and A.C. exhaust fans, for the 1912 season.

Messrs. James Keith & Blackman Co., Ltd., 27, Farringdon Avenue, London, E.C.—Leaflet relating to the advantages of the Blackman ventilating fans for summer service.

Messrs. T. & T. Vicars, 20, Bucklersbury, London, E.C.—Two booklets just issued relating to the Vicars mechanical stoker. One is a catalogue of 66 pages, in the first section of which are a number of elevations and sectional drawings of the stoker; the second part containing matter relating to the combustion of fuel and giving a general description of the stoker, showing the saving as compared with hand firing and giving test information. Section 3 briefly covers elevating and conveying plant, and No. 4 contains a number of tables of combustion, saturated steam, boiler efficiencies, and other

data; the last section includes a series of tables giving the heat values of 146 British coals. The accompanying brochure contains many pages of illustrations of various installations of the Vicars stokers, among them being electric light and tramway stations and many industrial works.

THE WESTMINSTER TOOL AND ELECTRIC CO., Suffolk House, Laurence Pountney Hill, London, E.C.—Leaflet No. W18 containing illustrations, brief notes and prices of the "Westminster" motor-boat and yacht lighting system of several types and sizes, type "A" being for sailing yachts which have no engine, and "B" for auxiliary yachts and motor-boats. Motor-boat electrical fittings are shown.

MR. G. BRAULIK, 8, Lambeth Hill, London, E.C.—4-page detailed price list of various qualities of carbons for open and enclosed arc lamps.

MESSRS. W. E. MOULSDALE & CO., 24, Chapel Street, Liverpool.—Illustrated leaflet relating to a 240-KW. steam generating set that is offered for sale.

LANGDON-DAVIES MOTOR CO., 110, Cannon Street, E.C.—Booklet of useful tables of H.P. and KW. equivalents, &c., and data relating to the company's standard A.C. and D.C. motors.

THE ELECTRICAL ENGINEERING AND EQUIPMENT CO., LTD., 109 and 111, New Oxford Street, London, W.C.—32-page catalogue (No. S 3) containing very fully illustrated particulars of a variety of fittings and accessories used in connection with street lighting. These include cast-iron water-tight reflector fittings for outside and exposed positions, multiple lamp fittings supplied for up to 2,400 C.P. for dock and street lighting, ornamental water-tight lantern fittings for metal-filament lighting, wall brackets and pendants, shop lighting and tramway standard fittings, lamp brackets and columns, contact gear and self-sustaining devices and parts for use in connection therewith, automatic safety winches, spring insulated suspenders for arc and metal-filament lamps, time switches and remote-control switches, automatic locking device for suspension fittings; various suspension methods are shown. Price information, code words and weights are given throughout the list.

THE ELECTRIC CONSTRUCTION CO., LTD., 9, New Broad Street, London, E.C.—Booklet (B/287) of eight pages containing illustrated descriptive information relating to the firm's E.C.C. removable panel ironclad switchboards.

MESSRS. SIEMENS BROS. & CO., LTD., Woolwich, Kent.—New pamphlet (No. B 527) describing with diagrams the Baudot type-writing telegraph apparatus of the latest and most developed form, as used in the General Post Office.

MESSRS. T. & J. JACKSON, LTD., 14, Park Road, London, N.W.—16-page catalogue of electric cooking apparatus. Its illustrations include views of electric restaurants fitted entirely with Jackson apparatus, while prices and views of the following are also given:—Electric ranges, rapid water boiler, electric oven, grills, breakfast cookers, boiling pans, fish frier, boiling plates, hot cupboards, kettles, urns, glue pots, sterilisers, instantaneous water heaters, &c.

THE TELEGRAPH CONDENSER CO., LTD., Vauxhall Street, Kennington Oval, S.E.—Illustrated catalogue of their hermetically sealed condensers, artificial cables with negligible coefficient (Dearlove patent), various types of adjustable condensers for duplex working, &c., standard condensers, complete duplex balancing sets and instruments for use therewith. A completed box of artificial line with a ratio of 4·96, and a total resistance of 104 ohms, is stated to have given, over a range of 21° F., a rise in resistance of less than 0·01 per cent. per ° F. A number of useful tables and curves relating to the temperature corrections of condensers, expansion of paraffin, &c., is given at the end of the catalogue, which is admirably produced.

MESSRS. UNITED BRASSFOUNDERS AND ENGINEERS, LTD., Empress Foundry, Cornbrook, Manchester.—Useful bound catalogue of 170 pages containing full information, together with illustrations, of a great variety of valves, cocks, gauges, lubricators, unions, whistles, governors, and other fittings for steam, water, heating, and fire, in gun-metal, brass, cast-iron, &c. Prices are clearly tabulated, together with weights, reference numbers, &c. The catalogue should be of great use to the trade, and interested parties who have not yet received a copy should make application for one.

Book Notices.—"Heat Engines." By Herbert A. Garratt. 1912. London: Edward Arnold. Price 6s. net.

"The Art of Illumination." By Louis Bell. 1912. London: Hill Publishing Co., Ltd. Price 10s. 6d. net.

"Report of the Annual Meeting of the American Institute of Consulting Engineers, January 16th, 1912." New York: The Institute.

"Lord Kelvin." By Dr. Silvanus P. Thompson, F.R.S. Published in French and English. 1912. London: International Electrotechnical Commission. Price 1s. 2d.

"The Central." Vol. IX, No. 27; also "List of Members and Rules of The Old Centralians." 1912. Reading: The Secretary, 98, London Road. Price 1s. 6d.

"Soren Hjorth; Inventor of the Dynamo-Electric Principle." By Ligurd Smith. 1912. Kobenhavn: *Elektroteknisk Forening.*

"Annuaire International de l'Acetylène, 1912." By R. Granjon and P. Rosenberg. Paris: l'Office Central de l'Acetylène. Price 3 fr.

"*Bulletin* de la Société Internationale des Electriciens." Vol. II, No. 14. April, 1912. Paris: Gauthier-Villars. Price 2 fr. 50 c.

"*Transactions* of the South African Institute of Electrical Engineers." Vol. III, part 2. March, 1912. Johannesburg: The Institute. Price 2s.

"Notes on Alternating Electric Current and Induction Motors." By T. Harding Churton. 1912. Leeds: T. Harding Churton & Co., Ltd.

"*Journal* of the American Society of Mechanical Engineers." May, 1912. New York: The Society. Price 35 cents.

"Bulletin Mensuel de la Société Belge d'Electriciens." March, 1912. Brussels: Emile Bruylant. Price 1 fr. 50.

"*Proceedings* of the Engineers' Club of Philadelphia." Vol. XXIX, No. 2. April, 1912. Philadelphia: The Club.

"*Boletin* de la Sociedad de Fomento Fabril." March, 1912. Santiago de Chile: The Society.

"Bulletin Scientifique de l'Association des Elèves des Ecoles Speciales." March, 1912. Liége: The Association. Price 75 cents.

"*Transactions* of the Illuminating Engineering Society." Vol. VII, No. 4. April, 1912. New York: The Society. Price 75 cents.

"Telephony." By Samuel G. McMeen and K. B. Miller. 1912. London: Crosby Lockwood & Son. Price 17s. net.

"*Journal* of the Franklin Institute." Vol. CLXXIII, No. 5. May, 1912. Philadelphia, Pa.: The Institute. Price 50 cents.

"Steam Boiler Construction." By Edward G. Hiller. 1912. Manchester: The National Boiler and General Insurance Co. Price 1s.

"Peru To-day." Vol. III, No. 12. March, 1912. Lima: The West Coast Publishing Co. Price 5d.

The Physical Review. Vol. XXXIV, No. 4. April, 1912. Lancaster, Pa.: The *Review* Office.

"La Telegraphie Sans Fil." By E. Monier. 1912. Paris: Dunod et Pinat. Price 2 fr. 50.

"*Engineering* Directory." April, 1912. London: *Engineering*, Ltd. Gratis.

Trade Announcements.—We learn that the firm of T. HARDING CHURTON & CO., of Atlas Works, Water Lane, Leeds, electrical engineers, has been converted into a private limited company, and will in future carry on business under the style of T. Harding Churton & Co., Ltd. The conversion has been made for private reasons only, and no part of the capital has been offered to the public. The directors of the company are Thomas Harding Churton, who is the governing director and the chairman of the company, and Sidney Herbert Smith. All debts and liabilities of the firm are undertaken by the company, and all debts due to the firm are to be paid to the company. The conversion will not affect the general conduct of the business, which will be carried on as heretofore.

MR. SAMUEL ATKINSON, electrical goods dealer, of Castleford (Yorks.), has removed his business from Sagar Street to new premises in Vickers Street.

MR. L. F. BRUNNER, has removed to 222, Romford Road, Forest Gate, London, E.

The new works and offices of the LIVERPOOL ELECTRIC CABLE CO., LTD., being now ready, the business will be transferred thereto on May 31st, when all correspondence should be addressed to Linacre Lane, Bootle, Liverpool. The telegraphic address will be as before—"Concentric, Liverpool"; Telephone number—"147 Bootle."

On May 18th MESSRS. ISENTHAL & CO. changed the address for offices and works to Denzil Road, Neasden, N.W.—their *only* address in future.

THE FREDK. CRANE CHEMICAL CO. have recently found it necessary to migrate from their old home in Newhall Hill, to a new factory designed to meet the requirements of the business, in Armoury Close, Bordesley Green, Birmingham. Here they have ample room for expansion for some years to come.

MR. H. B. ARNOLD, who recently resigned his position with Messrs. G. & H. Grevener, London, as their Northern representative, has now joined the staff of MESSRS. CARNEY & PEARN, LTD., and is taking charge of their supplies department, which he is re-organising and extending, so that the firm are now in a position to supply every class of electrical material for power and lighting. His new address is Nutsford Vale Works, Manchester, S.E.

MR. HARRY NANCE, electrical manufacturers' representative, 4, Church Street, Cardiff, is removing his offices and stores to larger and more convenient premises, and his address will henceforth be Dragon Buildings, Paradise Place, Cardiff.

Stoker Contracts.—Among orders recently booked by the UNDERFEED STOKER CO., LTD., of Coventry House, E.C., are the following:—

Portsmouth Dockyard generating station, six travelling grate stokers and air heaters; Swansea Corporation Electricity Works, four "E" type stokers; South Metropolitan Electric Light Co., four "E" type stokers; Corporation of Oldham, 16 "B" type stokers; Corporation of Sheffield, Sheaf Street, two "E" type stokers; Soc. Energia Electrica de Cataluna, Barcelona, 16 travelling grate stokers.

Osram Lamps.—THE GENERAL ELECTRIC CO., LTD., announce a reduction in the price of pear-shape Osram lamps of 20 to 30 volts, 5 to 16 C.P., to 2s. 1d. each. They now hold large stocks of low-candle-power Osrams, as follows:—100 to 135 volts, 11 watts, approximately 10 C.P.; 200 to 260 volts, 20 watts, approximately 16 C.P. The company can now supply from stock plain flame Osram lamps, candle-shape, 200-260 volts, 20 watts, 16 C.P., with drawn wire filaments. Hitherto the firm have only supplied these candle-lamps for low voltages, up to 130 volts.

Bankruptcy Proceedings.—H. JOHN WRIGHT, 69 Blackboy Lane, West Green, N.—At a sitting of the London Bankruptcy Court, held on Tuesday last week, before Mr. Registrar Linklater, this debtor attended for public examination upon accounts showing unsecured debts £305, contingent liabilities £180 (not expected to rank), and assets nil. Replying to Mr. Egerton S Grey, Official Receiver, the debtor stated that he had been employed

in the electrical trade since January, 1911, by a firm of electrical accessory suppliers. Judgment for £37 odd was obtained against him in September, 1911, by a creditor, and, a committal order having been obtained, he filed his petition on March 28th last. Witness attributed his failure and insolvency to his liabilities in connection with the Ferabin Lamp and Electrical Accessories, Ltd. The examination was concluded.

C. H. Steel, electrical engineer, Bradford (lately Cardiff). First meeting, May 30th; public examination, June 10th: both at Cardiff.

LIGHTING and POWER NOTES.

Accrington.—In his annual report on the electricity undertaking, the borough treasurer states that the gross income for last year was £19,452, and gross expenditure £10,872, leaving a revenue surplus balance of £8,580, representing 9·29 per cent. on the capital outlay. The number of consumers was 848, compared with 731, and the units supplied were 3,315,512 against 2,860,722. Average prices per unit:—Lighting, 3·661d.; power, ·953d.; public lighting, 3d.; tramways (for traction), 1·2d.; combined average, 1·349d.; working expenses per unit, ·787d. The borrowing powers amounted to £95,560, compared with £87,560 in the previous year.

Altrincham.—The B. of T. has granted a provisional order authorising the Altrincham Electric Supply Co. to supply electrical energy for all public and private purposes within such parts of the townships of Hale, Timperley, and Dunham Massey, as were not included in previous orders, as well as to the township of Baguley. Important building developments in these districts in the near future are anticipated.

Australia.—The demand for electric light and power in country districts in Victoria continues to grow, the transition in very many cases being the pronounced one from kerosene to electric lighting. *The Australian Mining Standard* says, with respect to the State as a whole, an official return, prepared recently, showed that up till then 42 undertakings had been authorised by Order-in-Council under the Electric Light and Power Act, including four electric tramways, and sixteen of the orders are held by municipal councils. The approximate amount of capital invested was £1,700,000, and the gross annual revenue about £265,000. The amount of capital invested by consumers of electric light and power in installations and machinery was set down at £470,000. The number of electric motors was estimated at 3,500, and the number of lamps 408.000. "There are also," the official report added, "about 80 private electric installations at mines, etc." Since that date over a dozen additional Orders-in-Council have been granted, mainly for country supplies, and the amount of capital practically invested is, therefore, considerably higher than the figures given above.

Ayrshire.—According to a statement made to the County Council the electric lighting scheme for Skelmorlie has been completed and is giving much satisfaction. The village is now lit by 85 metal lamps of 50 candle power, and the cost per annum is £158.

Ballybay (Co. Monaghan).—At a meeting of the Monaghan County Council, last week, an application was made by the Ballybay Gas Light Co. for permission to erect poles in the streets for the purpose of electric lighting. At the previous meeting of the County Council, a similar application was granted subject to the approval of the County Solicitor. Both parties addressed the Council, and the solicitor stated that having carefully considered both applications, he found that neither of the applicants had obtained a B. of T. licence under the Electric Lighting Act, 1882, and it appeared to him that in a small town like Ballybay, it was not desirable there should be two electric lighting undertakings, as their poles and wires would be crossing one another. It was, however, entirely a question for the B. of T. and the Castleblaney R.D.C., and he thought it would be advisable to communicate a copy of his letter to that body. After discussion, the Council passed a resolution that the terms of Mr. M. Murray, the earlier applicant, be adhered to.

Belfast.—The accounts of electricity undertaking for the year ended March 31st, 1912, showed that for the period a working profit of £32,496 had been carried to net revenue account, which had also been credited with £442 for bank interest, making a total of £32,939. After providing for loan charges amounting to £19,521, income-tax £470, and stamp duty £28, there remained to credit of net revenue account a disposable balance of £12,919.

Birmingham.—It is anticipated that notwithstanding the high price of coal during the strike, there will be a profit of about £50,000 on the electric supply department.

Blackpool.—An inquiry on behalf of the L.G.B. was held on April 15th, relative to the T.C.'s application for sanction to a loan of £10,000 for extensions at the electricity works, rendered urgently necessary to meet the increasing demands for lighting and power purposes.

Brazil.—At Parahyba, in the Parahyba do Norte Province, a new company with a capital of 3,000,000 dollars and the title of the "Empreza de Traccao, Luce Força de Parahyba do Norte" has been founded to build power and lighting stations in the aforementioned province. The directors of this new enterprise are:—Dr. Julio Bandeira, Dr. Alberto de S. Juan and Thiago V. Monteiro.

Large electrical works are to be erected near Pindamonhangaba, San Paulo. The Ribeirao waterfall will supply the power—about 4,000 H.P. The works will supply current to the towns of Taubaté and Tremenbé.

Broadstairs.—The Isle of Thanet Tramway Co. is erecting a sub-station in St. Peter's Road, in order to cope with the increasing demand for current

Chester.—A L.G.B. inquiry was held on May 16th respecting the proposed loan of the Corporation for providing hydro-electric works on the site of Old Dee Mills. The scheme proposes to develop 775 H.P. and be capable of supplying 1¼ million units per annum, and will replace, for the present, extensions of the Crane Street station, with a prospect of greater profits than if that station were extended. The Electricity Committee proposes to recommend the T.C. to accept tenders for buildings, £4,639; turbines, Gordon & Co., £4,693; dynamos, Lancs. Dynamo Co., £2,006; and switchgear, Crompton & Co., £269. The Chester Waterworks Co., and others opposed with a view to raising the weir to its original height, and the Conservancy Board were also represented.

Continental Notes.—Sicily.—La Société d'Electricité de la Sicile Orientale has recently established two large power stations to utilise the water power of the Rivers Alcantara and Cassibile. The plants, which have a capacity of 11,500 KW., are supplying electrical energy to all the principal towns on the east coast of Sicily, including Messina, Acireale-Catania, and Syracuse.

France.—A Bill has been introduced into the French Chamber by the Minister of Agriculture and Public Works, for the establishment on the River Durance of hydraulic works for the irrigation of the low lands on the right bank of the Rhone, and the working of agricultural water undertakings in the Mediterranean region. The scheme provides for the erection of hydro-electric generating stations on the Durance, near the watermeet of the River Verdon and the bridge at Pertuis. The power produced at these stations will be used for all kinds of agricultural purposes in the Departments of the Bouches-du-Rhone, Vaucluse, Gard, and Hérault. The surplus, after the satisfaction of these requirements, may be sold and delivered either to generating stations or distribution networks. These and supplementary works are estimated to cost 65 million francs, and the Bill asks for the sanction of a first expenditure of 300,000 fr. on account of preliminary studies.—*Revue Electrique.*

Coventry.—The City Council on Tuesday received the annual report and accounts of the electricity department for the past year, showing a net profit of £16,173. The engineer (Mr. G. Tough) reported that the total units sold during the year amounted to 10,473,339, as compared with 7,943,937 last year, being an increase of 2,529,402, or 32 per cent., the increase in the power load accounting for 2,470,163 of this amount. The total revenue for the year amounted to £50,682, an increase of 9·2 per cent.; the revenue from the power load increased from £29,839 to £33,719, or 13 per cent.; and the revenue from the lighting load, which is only 10 per cent. of the total load, increased from £13,550 to £14,196 this year, an increase of 4·8 per cent. The average revenue received per unit was 1·16d., compared with 1·40d. last year, being a reduction of ·24d., or 17 per cent. This was due to the revised scale of charges for meters, and reduced rates for power adopted by the Committee last year, but these reduced rates had been largely responsible for the heavy increase in the power load, which in turn had greatly reduced the capital charges per unit. The capital expenditure during the year amounted to £22,884, making a total capital expenditure to March 31st, 1912, of £294,085, which included a sum of £27,750 transferred at various times from the reserve fund, on account of superseded, or obsolete plant, &c. The total works cost per unit sold was reduced from ·378d. to ·325d., or 14 per cent. The coal per unit generated was 2·69 lb., as against 3·8 lb. in the previous year, being a reduction of not less than 6,100 tons on the year, and a saving of £2,440. The total coal cost per unit sold was reduced from ·164d. to ·135d., the very lowest coal costs ever recorded in the country. These low costs were brought about by the installation of the more efficient turbo-alternators (which are still the largest units in the Midlands), increased load, and a higher working efficiency. The total costs per unit, including capital charged amounted to ·72d., being a reduction of 15 per cent., and was ·03d. less than ·75d., which was the lowest charge for energy. This total cost of ·72d., deducted from the average revenue received, viz., 1·16d., left a net profit of ·44d. per unit, or 62 per cent. of the total cost, compared with ·56d. and 66 per cent. in the previous year. The cost of new meters, motors, &c., has no connection with the working costs and had to be deducted from the ·44d. per unit, leaving the nett profit, as per cost sheet, viz., ·37d. per unit. Plant has been scrapped and superseded during the year to make room for the third turbo-alternator now on order from the B.T.-H. Co. The remaining value of this plant scrapped and superseded amounted to £5,779, which amount will require to be provided out of profits this year, and go towards the cost of the present extension. The H.T. mains had been extended by 11,473 yd., and the L.T. mains by 11,419 yd., making a total of 22,892 yd. laid during the year, and the total mains laid to March 31st, 1912, amounted to 172,976 yd., being equal to 98 miles 496 yd. The number of consumers had increased from 1,590 last year, to 1,962 this year—an increase of 372, as compared with 297 last year.

Councillor Pridmore, chairman of the Electric Light Committee, in moving the adoption of the report, paid a high tribute to the

engineer. As to the demand for a greater sum out of the profits toward the relief of the rates, he contended that the needs of the undertaking must be the most important consideration, and that its success was dependent upon selling current at the lowest price possible, and the provision for ample depreciation of plant, in view of the rapid development of electrical science. The report was adopted, and the following revision of charges sanctioned :—Total consumption exceeding 250,000 units per quarter (1,000,000 per annum), charge reduced from ·75d. per unit to ·7d. ; exceeding 375,000 units per quarter (1,500,000 per annum), ·65d. per unit ; a further reduction of 5 per cent. to be allowed for every 10 per cent. increase of load factor above 40 per cent. Meter rentals to be abolished. The total estimated cost of these reductions was £1,000 per annum.

Barnes.—At the last meeting of the U.D.C. the electrical engineer suggested, owing to the development of the demand on the Lowther Estate during the past winter, the laying of a ·25-sq. in. concentric feeder to a point in Kitson Road, at an estimated cost of £620, and recommended the invitation of tenders for supplying the cable. This was agreed to.

Creswell.—The ratepayers here have accepted the offer of the Bolsover Colliery Co. to supply current for private lighting at 3½d. per unit.

Croydon.—The report of the year's work of the Corporation electricity undertaking, presented to the B.C. on Monday evening, stated that the main increase of business was in general supply, the greater output having been brought about by reductions in charges to consumers and more active publicity and canvassing work. Of the increase of 536,203 units sold, 430,206 were for lighting, power, heating and cooking. There was a larger demand for heating and cooking supplies, the possibilities of which would be very great, says Mr. Cramb, if the department could work on advanced competitive lines. "Unfortunately," he adds, "restrictions of Parliamentary powers at the present moment result in 75 per cent. of the inquiries for electric supply being turned away owing to the fact that consumers' requirements cannot be met." Concessions to consumers reduced the revenue by £3,076, but the total receipts were £62,593, an increase of £1,104. Consumers increased by 367 to 4,316. Regarding finances, besides the concessions to consumers, the appropriation of £3,500 to relief of rates, and the fact that £5,986 on the revenue account was charged against profits (a considerable proportion of which, the auditors certified, might have been regarded as capital expenditure), there was a surplus of £3,742, which was carried to the appropriation account. The reserve fund stood at £39,031, subject to a sanctioned expenditure of £15,400 chargeable to it. Ald. D. B. Miller (chairman of the Lighting and Electricity Committee) said that if they could they would have vetoed the £3,500 taken for the rates. He held out no hope of further concessions to consumers this year. He had great hopes that the Committee would get powers on the lines of the Bill now before Parliament promoted by the Municipal Electrical Association. He did not think the Bill, if passed, would injure contractors in any way. The new machinery, it was hoped, would save £1,000 a year on the fuel bill. The report and accounts were passed ; also an expenditure of £3,295 on various works in connection with distribution, of which £978 comes from revenue account.

Douglas (Isle of Man).—The T.C. has decided to issue circulars to possible consumers of electricity with a view to ascertaining what amount of current would be taken if an electrical undertaking is established. The circulars will contain the cost of wiring premises, the cost of lighting and other particulars.

Dundee.—The Electricity Committee of the T.C. has approved of the electrical engineer's proposal for the better lighting of the streets, and has sanctioned the replacement of 84 lamps of old design by a new form of arc lamp. The estimated cost of the proposal is £714.

Highbridge.—Dr. Purves, who is establishing electricity works at Burnham (Somerset), has approached the Council with respect to the extension of the supply to Highbridge, under an agreement. The Council has decided that the Lighting Committee shall confer with Dr. Purves.

Horsham.—By a large majority the U.D.C. has decided to proceed with the construction of a refuse destructor in connection with the electricity works on the lines suggested by the electrical engineer. It is estimated to cost £1,150, exclusive of alterations of buildings.

Kenmare.—The electric lighting works, after a somewhat chequered career, have we understand since being placed under the care of Mr. R. J. Campbell, been modernised and an up-to-date scheme of electric lighting adopted. An electrically operated mineral water works and the development of clay working in the vicinity are expected to provide a day load, while the growth of electric lighting has been most gratifying during recent months.

Llandudno.—The Council has decided, in order to encourage the consumption of electricity for heating purposes, to invite makers of the heating apparatus to give a demonstration in the autumn and will place the Town Hall at their disposal for the purpose, and give a free supply of electricity.

London.—Hackney.—It has been decided to borrow £3,468 from the L.C.C. for mains.

Fulham.—The Electricity Committee reports the result of negotiations with the Surveyor of Taxes on the subject of income-tax and depreciation allowance in respect of the electricity undertaking, to the effect that the approval of Somerset House authorities had been obtained to a statement showing that on April 5th last, the unexhausted depreciation may be regarded as £11,658. This statement the Committee states will have the effect of relieving the Council from payment of income-tax on the profits of the undertaking for several years to come. The Committee has decided to provide and fix a suitable 24-in. water strainer in connection with a condensing plant at the electricity works at an estimated cost of £185.

Marylebone.—As it is found that a residence consumer on the "telephone" system who uses electricity for lighting only, consumes 1d. units amounting in value, in a year, to approximately 25 per cent. of the amount he paid in advance by way of annual charge, the E.L. Committee proposes as an alternative that, after the annual charge has been calculated in the ordinary way under the "telephone" system, 33⅓ % shall be added to such amount to be paid in advance, and that all units consumed shall be calculated at ½d., further, that the rate per unit for residence consumers preferring the present annual charge under the "telephone" system be as follows : Up to 25 per cent. in value of the annual charge 1d., then up to full value of annual charge ¾d., and all beyond this ½d. There is practically no difference in results between the two proposals.

London (City).—At the last meeting of the Court of Common Council, Mr. Deputy Millar Wilkinson asked the chairman of the Streets Committee if he could give any information with regard to the rumour of the purchase of the City of London Electric Lighting Co. by the Corporation. In reply, Mr. G. Stanham said that he could only state that the matter would come before his Committee at the next meeting.

Islington.—The Lighting Committee reports having had under consideration a report from the electrical engineer as to the necessity for at once providing additional plant. Particulars of the plant proposed to be laid down, with the estimated costs are as follows :—One 3,000-kw. steam turbo-alternator, exciter and condenser, together with auxiliary plant and other accessories ; steam pipe connections, foundations, &c., cable, cable connections, switchgear and accessories, and circulating pipes, valves, &c., £12,600 ; contingencies, £400. The Committee recommended that it be authorised to invite tenders for the carrying out of the work and for the supply of the plant and machinery referred to. Alderman Vorley, in moving the adoption of the report, said that it had been fully discussed, and carried by a large majority by the Finance Committee. It was not desired that the loan capital of the undertaking should be greatly increased, and it was proposed that the reserve fund should be used in paying for the new machinery. They had accumulated £21,000, but they did not propose that that sum should be depleted by £13,000, as it was proposed to pay for the plant by instalments ; 40 per cent. on giving the order, another 40 per cent. 12 or 18 months afterwards, and 20 per cent. in three years' time. They expected that their surplus in the present year would almost pay for the first instalment, and that the surplus in the second would be more than sufficient to pay the second instalment. The third instalment would only be a trifle out of the surplus which accumulated in the third year, because having put down a more economical machine than they had ever done before, their works' cost would decrease considerably. After discussion, an amendment referring the matter back was carried.

Bermondsey.—At a meeting of the B.C. on Tuesday evening, a letter was received from the L.G.B., adverting to the refusal of the L.C.C. to sanction a loan for £18,872 for extending the electricity undertaking. The Board stated that it was unable to deal with the whole of the proposed loan of £18,872, as its power only extended to the determination of the appeal of the Borough Council against the decision of the L.C.C. not to sanction a loan of £18,563. It had arrived at this amount, and the Board stated it had deducted the sum of £162 in respect of debt outstanding on the foundations, which will be superseded, and that the loan was sanctioned on the condition that, whatever the actual cost of the proposed work be, it will be defrayed to the extent of £162 out of current income. The Town Clerk said that sanction to the loan bore out the contention he had always held, that the L.C.C. was not entitled to the information asked for. Discussion of the letter was adjourned.

Hammersmith.—The Electricity Committee reports that several large establishments in the borough have intimated their willingness to take a supply of current for lighting purposes if the Council is prepared to supply upon the unlimited service system, adopted successfully by Marylebone B.C. The Committee considers that this proposal should be adopted experimentally, and has decided to offer the following fixed rates of charges : 25 watts, 7d. per week per lighting point ; 50 watts, 10d. : 100, 1s. 6d. ; 200, 2s. 10d. ; 300, 4s. 2d. The above rates are to be limited to a consumption of 1,400 hours per annum, the Council supplying the current and undertaking the fixing and maintenance of the installation, and subject to an agreement being entered into for a period of not less than three years. The engineer estimates the total cost per week to the Council as follows : 25 watts, 4·75d. ; 50, 6·75d. ; 100, 11d. : 200, 19·75d. ; 300, 27·75d. The Committee has further decided, as an experiment, to set aside the sum of £100 for hiring out to consumers small electrical apparatus.

Lowestoft.—Sanction has been received from the L.G.B. to the borrowing of £1,962 for condenser plant, pumps, &c. ; £1,000 for street lighting ; and £1,500 for meters.

Manchester.—The City Council has discussed the proposal of the Electricity Committee to give £19,000 to the rates, and as was the case when a similar proposal was made last year, the amount was raised, by amendment, to £24,500, the chairman of the Gas Committee, seizing the opportunity to inform the Council that electricity had reached the limit with regard to lighting, although apparently, he conceded that it was useful for power.

Maldon.—The T.C. has decided to enter into an agreement with Messrs. John Sadd & Sons, Ltd., for the firm to have the right to provide current for public and private purposes for a period of ten years, the Council to have the option of purchasing the undertaking on giving 12 months' notice. The Council will also assist the firm to obtain a prov. order if one is desired during the ten years.

Mexborough.—The U.D.C. has instructed the E.L. Committee to submit a scheme for the development of the electricity undertaking, at an estimated cost of £8,000.

Nottingham.—An interesting feature of the annual report of the Electricity Committee is the reference to the disastrous explosion which occurred in the cellars of the Albert Hotel, on November 26th. The Committee admitted that persons who had sustained damage had good claims against the Corporation, and eventually they compromised them for a total sum of £4,791, in addition to a life annuity of £52. The capital sums paid have been taken from the reserve fund of the electricity undertaking.

The electrical engineer states that during the past financial year 14,690 additional 32-watt lamps, or their equivalent, have been connected to the mains, making a total of 435,012. There has been an increased demand for electricity for power purposes. One hundred and sixty-six additional motors, aggregating 575 H.P., have also been connected to the mains, making a total of 1,349 motors and 5,210 H.P. This is the largest increase since the commencement of the supply. The number of units sold during the year was :—For lighting, 3,803,553 ; for power, 2,734,570 ; for traction, 6,039,203 ; total, 12,577,326 units ; an increase of 632,799 units. 52·25 per cent. of the units used for private lighting were at the reduced rate of 1½d. per unit last year. The total working cost was 1·02d., compared with 1·04d. in the previous year. The sale of current yielded £94,863, and a balance of £44,061 was carried to the net revenue account, £28,380 going in interest, repayment of loans, &c., £14,850 in contribution to the rates, and £831 to the reserve fund.

Oulton Broad.—The U.D.C. having approached the Lowestoft T.C. for a supply of electricity for the district, the borough electrical engineer has been instructed to prepare a scheme, to undertake the supervision of it, and he is to be permitted to receive remuneration from the U.D.C. for his services.

Rugely.—An electricity scheme for the town, prepared by Mr. Chas. Balbiani, of Birmingham, has been submitted to the U.D.C., who will fully consider it at the June meeting. The scheme provides for the use of both underground and overhead cables, and the estimated capital cost is placed at £5,000. For the first year a loss of only £17 is anticipated, and afterwards a yearly profit.

South Africa.—The Robertson (Cape Province) Municipal Council proposes to obtain permission from the Administrator to enter into an undertaking for the purpose of lighting the town by electricity and to borrow a sum of £5,000 for that purpose. A meeting of ratepayers will be held on June 3rd to vote on the matter.

Swinton and Pendlebury.—A sub-committee of the Electricity Committee appointed to consider steps to be taken in connection with the forthcoming termination of the agreements with the Lancashire Electric Power Co. for a bulk supply and management of the undertaking, has considered Mr. Leach's report, and representatives have interviewed him. It was recommended that Mr. Leach be asked to prepare a statement setting forth the Council's proposals which will be forwarded to the Lancashire Electric Power Co.

Twickenham.—The U.D.C. has decided to invite alternative tenders for public lighting by electricity and gas, for one, three, or five years.

Worksop.—In connection with the application of the U.D.C. for sanction to borrow £6,670 for the extension of the electric lighting service of the town a public inquiry was held on Friday last, by Mr. H. S. Bidwell, inspector of the L.G.B. The electrical engineer (Mr. Crowther) explained the position of the undertaking from its commencement in 1902, and showed the rapid progress it had made, the total number of consumers at present being 996 compared with 84 in 1902, and the profit in 1911, £1,026 compared with a deficit in the first four years of its existence. The total expenditure to date on the electric lighting works is £31,244, and the authorised expenditure £31,073. The inspector at the conclusion of the inquiry proceeded to view the electric light works and the streets where overhead wires are proposed to be erected.

TRAMWAY and RAILWAY NOTES.

Belfast.—At the meeting of the Tramways and Electrical Committee it was decided to leave the question of universal 1d. fares over for another year. The City Accountant submitted the estimate of revenue and expenditure for the year ending March 31st, 1913, as follows : Revenue, £257,000. Expenditure—working expenses, £138,500 ; interest, £46,000 ; sinking fund contributions, £27,000 ; general purposes fund, £9,000 ; sundry net revenue charges, £3,000 ; depreciation, £13,000—total, £236,700. Estimated surplus, £20,000. The audited account of the tramways undertaking for the year ended March 31st, 1912, showed that the balance carried to net revenue account had been increased to £113,725. After providing for fixed charges and depreciation there was left to credit of appropriation account a balance of £23,871 transferable to the general purposes fund.

Bexhill-on-Sea.—The T.C., having been approached by the Commercial Association respecting a scheme of railless trolley cars for the town, has come to the conclusion that the time has not yet arrived when such a system can be adopted with advantage, as the system is to a very large degree still in its early and experimental stage.

Bingley.—Discussing the question of tramways in the area, the District Council said that the County Council had opposed the proposed scheme, apparently with a view to compelling the local authority to carry out road and bridge widenings at its own cost on county roads.

Birtley.—The P.C. has passed a resolution favouring the proposal of the Gateshead Tramway Co. to provide railless cars for the district.

Bolton.—The motormen, conductors and cleaners in the employ of the Corporation Tramways Department have asked for an increase in wages and reduction of hours. The Tramways Committee has made an offer, which has been refused.

Bradford.—A special meeting of the Tramways Committee has been held to consider the question of the Bingley extension, and it has been decided to approach the latter town with a view to ascertaining what inducement would be held out to the city.

Continental Notes.—FRANCE.—The Conseil Général of the Department of Haute Savoie has decided to electrify the tramway line from Annemasse to Samoëns, and the projected branch lines from the latter place to Sixt, and from the bridge at Fillinges to Habère-Poche. The estimated cost of these works is 4,500,000 fr. The Conseil has likewise decided to construct a tramway from Chapareillan to Bourget-du-Lac, thus affording through communication with Grenoble.—*Revue Pratique d'Electricité.*

Croydon.—The B.C., on Monday, resolved to spend £3,557 on track renewals in North and South-End, and High Street, adopting interlacing lines between certain loops. The cost is to come from the reserve and renewals fund.

Doncaster.—The Light Railway Commissioners have decided to issue an order, on the application for the Doncaster T.C., for the construction of electric tramways in the parishes of Balby-with-Hexthorpe, Warmsworth, Bentley-with-Arksey, and Ardwick-le-Street. Particulars of the scheme have been previously given in the ELECTRICAL REVIEW.

Dundee.—The tramways manager has been asked to prepare a report upon the practicability, and the probable expense of having hanging flower boxes placed on the tramway standards in the central parts of the city during the summer months.

Farnborough.—The U.D.C. has decided to lay before the B. of T. objections to the application from the Aldershot and Farnborough Light Railway Co. for an extension of time until June 4th, 1913, for commencing and completing the tramways in the district, on the grounds that sufficient time has elapsed for the company to have made a substantial commencement with the work ; that the delay is causing a stagnation of commercial enterprise as it prevents other means of transit being afforded for which there is an increasing demand ; and that as the matter has been under discussion by different companies for 14 years, the work should long since have been completed.

Greenock.—The Corporation Law and Finance Committee declines to agree to the proposal of the Greenock and Port Glasgow Tramways Co. to instal a system of railless traction in the upper part of the town on condition that the Council extend the present lease held by the company.

Ilford.—At the last meeting of the U.D.C., a resolution was moved to the effect that the Council appoint a tramways manager at a commencing salary of £400 per annum, rising to a maximum of £500 per annum. Councillor Bailey, in moving the resolution, said that the Council had about nine miles of track, and that the capital originally sunk in it was £180,000, of which about £30,000 had been paid off. An amendment was moved to refer the question to a meeting of the Joint Tramways and Electricity Committees, and Councillor Cullis, in supporting this amendment, said the undertaking could not stand another £400 or £500 a year. After further discussion, this amendment was carried.

London.—A correspondent of the *Financial News*, who has been investigating the progress of the East London Railway electrification, states that the Metropolitan Co. are to run this line, which will obtain power from the District Co.'s Lot's Road power station. The suggestion is that Metropolitan-Great Western joint trains are to be run *via* Aldgate to New Cross, and not District trains, as is generally understood.

HAMMERSMITH.—The Law Committee of the B.C. reports the receipt of a letter from the Referee appointed to determine the differences between the Borough Council and the London United Tramway Co., Ltd., with regard to the condition of the tramway tracks in the borough, stating that his award was now ready, and

would be handed to either party on the payment of 170 guineas, the amount of the costs of the award. The Committee has decided to take up same.

L.C.C. and Omnibus Traffic.—Last January the Roads Improvements Association complained to the B. of T. alleging that the L.C.C. tramway cars were causing obstruction of the streets. The Highways Committee has recently reported on the matter to the B. of T. The Association furnished particulars of the passengers using tramcars at certain times when traffic was light; the Committee has made observations between 9 a.m. and 5 p.m. of motor-'bus traffic on two typical days, and finds the average of the eight places observed to be 10·65 and 9·02 passengers per 'bus respectively. At three of these points the average number of tramcar passengers were 11·35 (first day) and 13·99 (second day); 4·36 and 8·30, and 4·27 and 7·94 higher than on the omnibuses. As there was ample accommodation on the cars for the 'bus passengers, and the cars were in operation before the 'buses on these routes, the report suggests that it is the omnibus companies which have placed unnecessary vehicles on the streets. To obtain further information as to 'bus traffic between 9 a.m. and 5 p.m. at busy centres, observations were made at Charing Cross, Piccadilly, and Oxford Street, when 5,480 'buses were noted (average 685 an hour), and the average number of passengers per 'bus was 10·97. From this, the report suggests that the Association's charge as to running too many cars, applies equally to the 'bus companies. In practice, however, the Council between 10 a.m. and 4 p.m. only runs 63·9 per cent. of the cars running for the morning and evening traffic, and the receipts on the day cars are higher than on those run during busy morning and evening hours, although the cars are then filled to their full capacity.

The report states further that, if electric cars were entirely withdrawn and the same seating accommodation had to be provided by motor-omnibuses as is now provided by tramcars, 2,688 omnibuses, or an increase of 114 per cent. of vehicles over the number of tramcars would be required during fine weather, while during inclement weather, when only the inside seats of omnibuses are fit to be used, 5,712 omnibuses, or an increase of 354 per cent., would be required. The Walworth Road route may be taken as an instance of the addition which would be made to the congestion of the streets if omnibuses were entirely to take the place of tramcars. During the busy period of each week-day morning, 70 omnibuses and 100 tramcars pass any given point in Walworth Road in one hour. If the electric cars were withdrawn and the same accommodation were given by omnibuses, the result would be, on a dry morning, 284 omnibuses an hour, and, on a wet morning, 603 omnibuses an hour. At present there is a tramcar every 141 yards; with 284 omnibuses, there would be one of these vehicles every 50 yards; with 603, there would be an omnibus every 23 yards in each direction. This calculation is based on a speed of 8 miles an hour—a speed which could hardly be exceeded even if it were practically possible to run such a service of omnibuses.

As regards congestion at junctions, 462 cars an hour pass the Elephant and Castle junction, 988 'buses an hour, in addition to the present service, would be required to give the same accommodation in fine weather, and 2,099 additional 'buses if wet. An observation at the junction of 'buses passing to and from New Kent Road between 10 a.m. and 4 p.m. showed that 303 'buses passed, carrying an average of only 3·61 passengers per 'bus.

The report points out that heavy vehicles obstruct tramway traffic; that obstruction occurs at every street junction where there are no tramways; that the tramways pay £118,000 annually for keeping the track paving in the centre of the road in repair and relieve the ratepayers of expenditure on that portion of the road; that the tramways have contributed nearly half a million to the cost of road widenings, while other passenger traffic undertakings have contributed nothing; and that more than 42 million passengers are carried annually at workmen's fares, which only defray working costs, without regard to capital charges, and that no other form of street transport caters for this class of traffic.

Manchester.—The Tramways Committee is considering the question of underground tramways as a means of adequately relieving the congestion of traffic in the central area of the city. The committee is actively prosecuting inquiries of Continental and American municipal authorities who have underground systems relative to the question of cost and construction. The idea is to have a central station on the old infirmary site at Piccadilly, from which there should be a line tapping the railway stations at London Road, Victoria, Exchange, Central, Oxford Road, and finishing up a circular route at Piccadilly. At present the Corporation has about 600 trams, and the congestion is getting worse every year.

Nottingham.—The annual report of the Tramways Committee states that the receipts, exclusive of interest on investments, amounted to £162,597, an increase of £5,308. The average per mile was 11·22d., an increase of ·09d. over the previous year. The working expenses amounted to £106,162, the average per mile being 7·32d., compared with 7·37d. during the previous year. The balance, amounting to £56,435, had been disposed of as follows:—To interest on stock and loans, £14,969; to repayment of capital, £19,302; to reserve and renewals fund, £4,163; in aid of general district rate, £18,000. In addition to the general overhaul and maintenance of cars, a further 10 were fitted with top covers, making a total of 110 so fitted, and a further 10 were equipped with electro-mechanical track brakes. A considerable reduction in the working hours, and increases in the rates of wages of motormen and conductors were made early in November at a cost of about £3,500 per annum, which also necessitated the employment of an additional 44 men. The cars ran 3,476,262 miles, or an increase of 87,552. The consumption of electrical energy for traction, car and depôt lighting, works machinery, and permanent way maintenance was 6,039,203 units, an average of 1·73 units, and 2·17d. per mile. The number of passengers carried was 36,026,471, an increase of 767,404.

Southport.—At a special meeting of the Traders' Association on Thursday last week, a recommendation was passed urging the appointment of a separate committee and manager for the Corporation tramways, and the taking of a plebiscite on Sunday running. The Corporation was also advised to consider the purchase of the tramway company's interest in Greater Southport. Alderman Griffiths said on the latter point the company still had a lease of 10 years to run. Councillor Hodson said the linking up of the undertaking would be an inestimable boon to the development of Ainsdale and Birkdale.

Stalybridge.—At the time of writing, efforts to settle the tramway strike on the Joint Board's system have proved futile.

TELEGRAPH and TELEPHONE NOTES.

Automatic Telephony.—On Saturday last the automatic telephone exchange at Epsom was brought into operation, with satisfactory results; it is on the Strowger system, and is connected to 320 subscribers' stations.

Chile.—A concession of the duration of ten years has been granted for the telegraphic and telephonic connection of Valparaiso and Santiago. There will be a midway station at Curacavi. The work will be commenced in the coming autumn, and it is hoped to complete it within the year.

Hull.—At a meeting of the Hull Corporation Telephone Committee on Monday, it was stated that after all charges against the undertaking for the past year had been met, the profit was £1,684, against £1,168 a year ago.

Marconi House.—On Thursday last week the new premises of Marconi's Wireless Telegraph Co., Ltd., in the Strand, were formally opened for business. The area of the site is about 54,500 sq. ft., and the buildings comprise nine floors, with three lifts and five staircases. There is a telegraph office on the ground floor, open night and day, from which messages are forwarded by a private wire to the Clifden wireless station for dispatch to the United States and Canada, thus saving time. An intercommunication telephone system with a 100-line switchboard, and two P.O. exchange boards with five extra points and 50 extensions each, are provided on the ground floor, on which the transfer department and the postal room are situated; on other floors palatial accommodation is provided for the managing director, secretaries, accountants, engineering staff, Mr. Marconi himself, and the numerous departments into which the business of the company has been organised. Electricity is supplied by the Charing Cross Co. at 200 volts D.C. for lighting, driving the lifts and sewage pumps, &c. A pneumatic tube system with eight stations, operated by an an electrically-driven blower, conveys letters from all parts of the building to the postal department, and small electric lifts carry baskets of letters and Dictaphone records to and fro—the Dictaphone being largely used. The intercommunication telephones, bells and fire alarms were installed by Messrs. W. G. Hodgson & Co.; Messrs. F. Geere Howard carried out the electric light installation. Magneta clocks are installed throughout. A wireless equipment will be installed shortly, for demonstration purposes. The furnishing, decoration, and equipment of the new headquarters of the company have been carried out in first-class style, and the Marconi House forms a worthy home for the great undertaking with which it is associated.

It is interesting to note that since the loss of the *Titanic* there has been an urgent demand for wireless operators, in order to provide two on each ship, and a school has been established in the new premises for the purpose of completing the training of operators.

Post Office Estimates.—On Monday a statement was made by Mr. H. Samuel, on the vote for £13,880,960 for the postal service. The P.M.G. pointed out that this year a full year's expenditure on the telephone system was provided for, as compared with one quarter in the last estimates, and this accounted for an increase of £3,079,000. The increase in the revenue was estimated at £3,475,000. The department contemplates the construction of a tube railway from east to west in London, to carry mails and parcels. The night letter telegram system is to be extended to all towns where night staffs are employed, and telephone numbers will shortly be made available as telegraphic addresses. A system of urgent telegrams at three times the ordinary rates is under consideration, for continental messages only. The question whether wireless installations shall be made compulsory on board passenger ships is receiving the attention of the department and the Board of Trade. The P.M.G. is firmly opposed to the suggestion of a State-owned Atlantic cable. A new cable will be laid between Britain and Germany, and a new system of urgent telegrams is under contemplation. About 19,000 employés were taken over from the National Telephone Co., and these are receiving in wages alone £175,000 a year more than formerly, while the shortened hours of work and increased holidays involve an increase of £32,000 a year, and the pensions rates will eventually require an extra £20,000.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Victoria.—June 4th. 1,000 protectors, galvanised iron wire, galvanised steel wire and sleeves, for the P.M.G.'s Department. See "Official Notices" April 19th.

June 11th.—Electric incandescent lamps and silk-covered wire, for the P.M.G.'s Department. See "Official Notices" April 26th.

June 11th.—(*a*) 1,237 electricity recording meters; (*b*) 3 tons 12 cwt. of bare hard-drawn aluminium cables, for the Melbourne City Council. See "Official Notices" to-day.

Melbourne.—June 18th. 50½ miles of cable, for the P.M.G.'s Department. See "Official Notices" May 3rd.

P.M.G., Melbourne.—July 23rd. Nine sections of a lamp-signalling trunk-line switchboard. See "Official Notices" April 5th.

June 4th.—The Agent-General for Victoria is prepared to receive tenders for certain works in connection with the electrification of the Melbourne suburban railways. See "Official Notices" May 3rd.

Tasmania.—June 10th. Telegraph and telephone material, for the P.M.G.'s Department. See "Official Notices" April 12th.

N.S.W. Government Railways and Tramways.—June 10th and 18th. Steam piping and fittings for Ultimo Power House. June 17th.—Two coal elevators and conveyors, for White Bay Power House. July 1st.—200-kw. motor-generator set for the Ultimo Power House. Specifications from the Electrical Engineer's Office, 61, Hunter Street, Sydney.

Western Australia.—July 31st. P.M.G.'s Dept. Telegraph and telephone material. See "Official Notices" May 10th.

New South Wales.—July 31st. Common battery and automatic switchboards, for Newton, Glebe & Balmain, for the Postmaster-General's department. See "Official Notices" May 17th.

South Australia.—October 1st. Telephone switchboards at Unley, Adelaide, for the Postmaster-General's department. See "Official Notices" May 17th.

October 1st.—Telephone switchboards at Norwood, for the P.M.G.'s department. See "Official Notices" to-day.

Bedlington.—May 29th. Poles, cables, &c., for electric lighting of Stakeford district, and poles, cables, lamps, &c., for extensions at Cambois. Particulars from Mr. J. E. Johnston, surveyor to U.D.C., Bedlington.

Belfast.—June 10th. Extension of the lighting and traction switchboards, for the Corporation. See "Official Notices" May 17th.

Belgium.—June 12th. The Société Nationale des Chemins de Fer Vicinaux, of Brussels (14, Rue de la Science), is inviting tenders for the construction of the overhead work in connection with the Roue-Zuen section of the Brussels-Hal light railway.

June 13th.—The Société de l'Exposition de Gand (Rue des Moineaux, Ghent), is inviting tenders for the supply and installation of the electric lighting plant for the Galerie des Machines, at the forthcoming Ghent Exhibition.

Bettws-y-Coed.—June 4th. Underground cables, transformer pillars and public lighting apparatus, two water-turbine-alternators and pipework, high and low-pressure switchgear and connections, for the U.D.C. See "Official Notices" May 17th.

Birkenhead.—May 27th. Electric light installation at the Union Workhouse, Tranmere, for the B. of G. See "Official Notices" April 26th.

Bolivar.—The municipality of Bolivar will shortly call for tenders for an electric light station.—*Review of the River Plate.*

Bristol.—June 3rd. Arc lamp carbons (No. 122) and incandescent electric lamps (No. 123), for the Docks Committee of the T.C. W. W. Squire, engineer, Cumberland Basin.

June 10th.—Wiring and fittings for electric lighting at Stapleton Workhouse, for the B. of G. See "Official Notices" to-day.

Buenos Aires.—"The Department of Engineers of the Province of Buenos Aires have reported unfavourably on the four tenders received for the electric lighting of Florencio Varela, and recommend that fresh tenders be called for. The same result will be the outcome of their study of tenders for a station at Pilar."—*Review of the River Plate.*

Cleckheaton.—June 1st. Slack coal (1,600 tons), for the Electricity Department of the U.D.C. J. H. Linfield, clerk.

Constantinople.—June 15th. Tenders are invited for the establishment of electric tramways in the Asiatic part of the capital. Particulars, in French, from the Minister of Public Works on forwarding the equivalent of 10s. in Turkish money (half of £T).

Derby.—One water-tube boiler, for the Corporation Electricity Department. See "Official Notices" May 3rd.

Devonport.—June 8th. Cables, wires and house fuse boxes, for a year, for the Corporation. See "Official Notices" May 17th.

June 13th.—Steam coal (5,000 tons), for the Corporation electricity works. J. W. Spark, borough electrical engineer, Newport Street, East Stonehouse.

Dumfries.—The County Council invites tenders for the electric lighting of the Sheriff Court House, Buccleuch Street. Mr. W. Arnot, 163, Hope Street, Glasgow.

Epsom.—May 28th. Maintenance of storage battery at the U.D.C. electricity works. See "Official Notices" May 17th.

France.—June 5th. The French Post and Telegraph authorities in Paris (103, Rue de Grenelle) are inviting tenders for the supply of a multiple telephone switchboard for the Telephone Exchange at Roubaix.

June 15th.—The French Post and Telegraph authorities in Paris (103, Rue de Grenelle) are inviting tenders for the supply of a multiple switchboard for the telephone exchange in the town of Tours.

Glasgow. May 27th. Erection of substation, Shawpark Street, Maryhill. W. W. Lackie, electrical engineer.

May 29th.—The T.C.'s Electricity Department invites offers for the supply and erection of overhead travelling cranes for the following sub-stations:—(1) Osborne, (2) Dennistoun, (3) Byres Road, (4) Maryhill. Specifications and forms from W. W. Lackie, electrical engineer.

Gloucester.—Forty-five street-lighting lanterns for high-candle-power tungsten lamps, for the City Electricity Department. See "Official Notices" May 3rd.

Huddersfield.—Electric lighting of proposed new banking premises in Westgate, for the West Yorkshire Bank, Ltd. Apply Messrs. J. C. Gibson, Skipworth & Gordon, architects, 5, Old Bond Street, London.

Keighley.—From 5,000 to 7,000 tons of steam coal, for the Corporation Electricity Department. Borough Electrical Engineer.

Liverpool.—June 4th. Electrical fittings, &c., for a year, for the Overhead Railway Co., Ltd. E. J. Neachell, general manager, 31, James Street.

London.—June 3rd. Battery boosters and switchboard, for the Westminster Electric Supply Corporation, Ltd. See "Official Notices" May 10th.

Poplar.—June 19th. Renewal of sub-circuit wiring, fuseboards, &c., at the Workhouse, for the B. of G. See "Official Notices" to-day.

Hackney.—June 27th. Boiler plant, induced-draught plant, economiser, feed pumps, coaling plant, &c., pipework &c., travelling crane, turbo-alternator, motor-generator or motor-converter, switchgear, &c., for the B.C. See "Official Notices" May 17th.

Islington.—May 30th. Electric lighting installation at the Receiving Homes for Children, for the St. Mary, Islington, Guardians. See "Official Notices" May 17th.

Hornsey.—June 10th. One electrically-driven turbine feed pump, for the T.C. See "Official Notices" to-day.

Manchester.—June 3rd. Electricity department. For Stuart Street generating station; electrically-driven coal-conveying plant. Specification, &c., from the secretary, F. E. Hughes, Town Hall, Manchester. Deposit £1 1s. (returnable).

June 5th.—Electricity department. Tenders for annual stores. Particulars and forms of tender can be obtained up to May 25th (in writing only) from F. E. Hughes, secretary, Electricity Department, Town Hall, Manchester.

Margate.—June 3rd. Two electrically-driven vertical spindle rotary sewage pumps, with one set of automatic starting and stopping gear, for the Corporation. See "Official Notices" to-day.

New Zealand.—July 1st. Public Works Department. Supply of machinery and material for the Lake Coleridge electric power scheme. See this column in our issue of April 12th.

Rochdale.—June 5th. Extra-high-pressure three-phase switchboard, for the Corporation. See "Official Notices" May 17th.

Sheffield.—May 31st. Electricity department. Contract 84, three water-tube boilers, mechanical stokers, economisers, steam and feed piping, &c. Contract 85, coal shoots and supports and measuring chambers. Specifications, &c., £1 1s. each (returnable), from S. E. Fedden, engineer and manager, Commercial Street, Sheffield.

South Africa.—June 26th. Boksburg. Rolling stock, converter plant and overhead material for the railless trolley system. See reference to this matter in E.R., May 17th.

Spain.—June 1st. Tenders are being invited by the municipal authorities of Alosno (province of Huelva) for the electric lighting of the town during a period of twenty years.

Stockport.—June 11th. One or more 1,500-kw. mixed pressure turbine alternators, for the Corporation. See "Official Notices" to-day.

Uruguay.—MONTEVIDEO.—June 20th. Tenders are invited for the supply and erection of four electric turn-bridges of 1,500 kg. each, with 800 metres of rails, for the Customs warehouses. Terms, &c., Harbour Secretary, Calle Piedras No. 156, Montevideo.

Walthamstow.—May 31st. Stoneware conduits, for the U.D.C. Electricity Department. See "Official Notices" May 17th.

West Ham.—June 5th. Refuse destructor and steam-raising plant in connection with the Canning Town generating station, for the Council. Specification (£1, returnable) from the Borough Engineer, Town Hall

June 17th.—Installation of electric light at the Education Offices, The Grove, Stratford, and Colegrave Road schools, Stratford, for the Education Committee. See "Official Notices" to-day.

Worksop.—May 28th. Storage battery and surface condensing plant for the U.D.C. See "Official Notices" May 17th.

York.—May 31st. Telephones and fire alarms, for the B.G. Geo. Sykes, Clerk, Museum Street.

CLOSED.

Ashton-under-Lyne.—The B. of G. on May 16th, decided to accept the tender of Mr. R. Butterworth, of St. Michael's Square, Ashton, for the electric lighting installation at the Workhouse, at £450. At a previous meeting the tender of Messrs. J. Swainson, of Manchester, was accepted, but this has been rescinded, so that a local trader may have the work.

Australia.—The *Australian Mining Standard* states that the tender (about £19,000) of the British Insulated and Helsby Cables, Ltd., has been accepted for the carrying out of the reticulation of Hobart (Tas.) and suburbs for the Hydro-Electric Power and Metallurgical Company. The work is to be put in hand as soon as possible, in order to prepare for the company's lighting contracts with the City Council and the suburban municipalities.

P.M.G., SYDNEY.—Various quantities of switchboard cable have been ordered from W. T. Henley's Telegraph Works Co., Ltd., and one wire-testing machine from Joshua Buckton & Co., £195.—*Australian Mining Standard.*

Bedford.—The T.C. has accepted the tender of Messrs. J. E. Page & Co. for 500 tons of Cotes Park coal for the electricity works at 14s. 3d. per ton.

Government Contracts.—The following tenders have been accepted during the past month by the Government departments named:—

WAR OFFICE.

Travelling electric crane.—Herbert Morris, Ltd.
Electric motors.—Lancashire Dynamo and Motor Co., Ltd.
Installation of electric light and power, Military Hospital, York.—G. E. Taylor & Co.

INDIA OFFICE: STORE DEPARTMENT.

Conversion of cranes.—Lancs. Dynamo, &c., Co.
Electric plant.—British Westinghouse Electric, &c., Co.
Fans.—Veritys, Ltd.
Transformers, &c.—British Westinghouse Electric, &c., Co.
Wire.—W. T. Glover & Co.; Whitecross Co.

CROWN AGENTS FOR THE COLONIES.

Cables.—Callender's Cable and Construction Co., Ltd.
Condensing plant.—Brush Electrical Engineering Co., Ltd.
Tubular telegraph posts.—J. Russell & Sons, Ltd.; Siemens Bros. & Co., Ltd.

OFFICE OF WORKS.

Lamp standards in Mall.—W. T. Allen & Co.
Two electric lifts, Courts of Justice extension.—Medway's Safety Lift Co.

GENERAL POST OFFICE.

Telegraphic apparatus.—Gell perforators, Gell Telegraphic Appliance Syndicate, Ltd.; receiver, trains, bases, &c., Siemens Bros. & Co., Ltd.
Telephonic apparatus.—Loading coils, Western Electric Co., Ltd.
Switchboards.—British L. M. Ericsson Manufacturing Co., Ltd.
Cable.—I.R. and C.C.; British Insulated and Helsby Cables, Ltd.; Western Electric Co., Ltd.; W. T. Henley's Telegraph Works, Ltd.
I.R.V. and C.—Johnson & Phillips, Ltd.
Paper core.—Callender's Cable and Construction Co., Ltd.; Johnson and Phillips, Ltd.
Submarine.—Siemens Bros. & Co., Ltd.
Earthenware ducts.—Albion Clay Co., Ltd.
Wire.—Copper, T. Bolton & Sons, Ltd.
Flameproof.—C. Mackintosh & Co., Ltd.; London Electric Wire Co. and Smiths, Ltd.
Electric lighting, S.E. District P.O., Borough, S.E.—Pinching & Walton.
Storage battery, G.P.O., Birmingham.—Premier Accumulator Co., Ltd.

Hertford.—The B. of G. has accepted the tender of the North Metropolitan Electrical Supply Co., Ltd., for a motor engine, &c., for the laundry, which is to be worked by electricity, at £70.

Horsham.—The Council School managers have accepted the tender of Messrs. Sendall & Co. for the electric lighting installation at Denne Road and Victory Road schools.

India.—The Walsall Electrical Co., Ltd., have received the contract for supplying the power distribution boards for the Jhansi workshops of the Great Indian Peninsula Railway Co., amounting to £239.

London.—L.C.C.—The Highways Committee received tenders as below for roadwork and platelaying for the Forest Hill to Rushey Green tramway:—

Kirk & Randall	(recommended) £19,418
G. Wimpey & Co.	19,528
Dick, Kerr & Co., Ltd.	20,243
J. Mowlem & Co., Ltd.	20,997
A. N. Coles	20,578

Several pyrometers for Greenwich generating station are to be ordered from the Cambridge Scientific Instrument Co., Ltd., for £250.

SOUTHWARK.—In our last issue we reported that the Council had accepted the tenders of Kabelfabrik-und-Drahtindustrie Joint Stock Co., of Vienna, for cable. We should, however, have stated that that company's tenders had been *recommended* for acceptance. As a matter of fact the Council accepted the tenders of the Western Electric Co., Ltd., at £112 and £69 respectively.

River Plate.—The *Review of the River Plate* states that the "Government has accepted the tender of Messrs. Lassout & Co. for the electric installation in the asylum at Oliva, at a cost of $109,989·25 m/n., and in the asylum at Torres, at a cost of $55,106·66 m/n."

The same exchange says that Messrs. C. H. Walker & Co., Ltd., have just placed an order for four 170-KW. three-wire 500-volt "Witton" dynamos, to be coupled direct to four Diesel engines, which will be used in connection with the construction of the Buenos Aires Port extension.

Southampton.—The B. of G. has accepted the tender of Messrs. W. G. Heath & Co. for the electric lighting installation at the Infirmary.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

Commanding Officer—LIEUT.-COL. H. M. LEAF.

The following orders have been issued for the current week:—

Monday, May 27th.—Bank Holiday.
Tuesday, May 28th.—"B" Company. Infantry drill, 7.30 to 9.30 p.m. Recruit instruction, 7 p.m. to 10 p.m.
Wednesday, May 29th.—All Companies. Annual musketry at Purfleet. This is the last date on which members can fire to make themselves efficient in musketry.
Thursday, May 30th.—"C" Company. Infantry drill, 7.30 to 8.30 p.m. Technical work, 8.45 to 10 p.m.
Friday, May 31st.—"D" Company. Infantry drill, 7.30 to 8.30 p.m. Technical work, 8.45 to 10 p.m.
Saturday, June 1st.—Headquarters will be opened for regimental business from 10 a.m. till 12 noon.

(Signed) P. H. CAMPBELL, Capt. R.E., and Adjt.,
For Officer commanding L.E.E.

International Electrotechnical Commission.—The Special Committee, appointed at Turin in 1911 to consider the rating of electrical machinery, held its first meeting in Paris from Monday, May 6th, to Thursday, May 9th, inclusive. Monsieur R. V. Picou (president of the French Committee) welcomed the delegates on behalf of his colleagues. M. Paul Boucherot was unanimously elected to preside over the meetings.

The discussions covered a very wide field. Probably the most interesting points discussed, and upon which definite suggestions have been made, were:—The question of the surrounding air temperature, temperature limits and the methods of measuring them, and the information to be carried on the name plates, and to be asked for when machines are bought and sold without any special specification.

The vexed question of "overloads" was discussed at very considerable length, and though at first it appeared as if the Special Committee would be unable to put forward any suggestions on this subject, a compromise was finally reached, which, it is hoped, will meet the views of those who desire that an overload be specified for the purposes of comparing different machines, and those who, on the other hand, are of opinion that an overload should be considered as entirely special.

The question of international agreement in reference to the resistivity of copper was submitted by Mr. C. O. Mailloux, delegate of the American Committee, and supported by M. Paul Janet, a member of the French Committee, and director of the Laboratoire Central d'Electricité. The Committee viewed the proposal most favourably, and expressed the hope that the figure recommended by the Bureau of Standards of Washington in consultation with the British, French, and German National Laboratories, would be adopted internationally.

As far as Great Britain is concerned the suggested figure, if adopted, will necessitate an alteration of only one-eighth of 1 per cent. in the present standard, which is practically an insignificant alteration from the commercial point of view.

The proposals of the Special Committee will be submitted, in French and English, to the various Electrotechnical Committees for their consideration, and the Committee will meet again in December in order to take into account any observations or modifications received.

It is hoped that the proposals of the Special Committee will be duly adopted by the I.E.C. at its plenary meeting, which will take place in Berlin in 1913, probably during the month of September.

FORTHCOMING EVENTS.

Royal Institution.—Friday, May 24th. At 9 p.m. Discourse on "Recent Advances in Agricultural Science—The Fertility of the Soil," by Mr. A. D. Hall.
Friday, May 31st. At 9 p.m. Paper on "Icebergs and their Location in Navigation," by Prof. Howard T. Barnes, F.R.S.

Royal Society of Arts.—Monday, May 20th. At 8 p.m. Howard Lecture on "Heavy Oil Engines," by Capt. H. Riall Sankey. (Lecture IV.)

Physical Society.—Friday, May 31st. At 5 p.m. At the Imperial College of Science, South Kensington. Papers on "The Calibration of Wave-meters for Radio-telegraphy," by Prof. G. W. O. Howe; and "On the Use of Heaviside's Resistance Operators in Air-Core Transformer Theory," by Dr. W. H. Eccles.

NOTES.

Institution and Lecture Notes.—TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION.—On the occasion of the Mumbles Congress, of June 27th and 28th, the following are among the subjects to come under discussion:—

"The Respective Values of Tramways, Motor-'Buses and Railless Traction as Means of Transport," by Mr. A. H. Pott, chief engineer of the Metropolitan Electric Tramways, Ltd.
"How to Secure the Best Results from Car Meters," by Mr. W. Clough, general manager, Bury Corporation Tramways.
"Track Maintenance," by Mr. W. Thom, general manager, Potteries Electric Traction Co., Ltd.
"Pay-as-you-Enter and its Advantages to Tramway Companies and the Travelling Public," by Mr. H. M. Howard.

There will be a banquet at Swansea, given by the Mayor and Corporation of Swansea, on June 27th, and one at Mumbles, by the British Electrical Federation, on June 28th.

THE ELECTRICAL CONTRACTORS' ASSOCIATION (INCORPORATED).—The annual dinner of this Association will be held on Monday, June 17th, at Frascati's Restaurant, Oxford Street, W., at 7 o'clock p.m. Tickets can be obtained from the hon. sec., Mr. L. G. Tate, 20, Bucklersbury, E.C., or any of the members of the London Section at 10s. 6d. each, exclusive of wines, &c.

ASSOCIATION OF MINING ELECTRICAL ENGINEERS (WEST OF SCOTLAND BRANCH).—At a meeting in Glasgow, on Saturday, the discussion was resumed on the paper contributed by Mr. R. W. Peters, Lochgelly, on "Earthed *v.* Insulated Neutrals in Colliery Installations." Mr. H. A. McGuffie, Glasgow, said that the local conditions should be very carefully weighed before either method was adopted, especially the earthed system. He did not agree with the use of only one resistance in the neutral connection, but preferred a resistance to be inserted in each generator and transformer neutral. This gave many advantages which entirely outweighed the extra cost. Mr. S. A. Symon said that for medium-pressure plant above 200 volts, especially when used with portable or semi-portable apparatus, or in a position where accidental contact with live parts was not unlikely to occur, it was safer to work with the insulated neutral. In low-pressure systems an earthed neutral could be adopted without danger of shock.

THE INSTITUTION OF ELECTRICAL ENGINEERS (STUDENTS' SECTION).—The report of the session 1911-12 states that the average attendance at the meetings in London has been about 40, the highest recorded being 62. Five Students' Premiums were awarded by the Council at the end of last session to Messrs G. W. P. Page and G. J. Scott (£10); Hugh C. May, Allan Monkhouse, R. C. Plowman, E. F. Hetherington and A. R. Stelling (£5 each). An important matter under discussion is a proposal that the Committee should examine papers offered for reading at the general meetings, and should suggest modifications and rearrangements of the material, and generally assist the authors to make their papers more suitable for reading before the students. The Committee are also considering the question of the exchange of papers and ideas between themselves and the Local Section Students' Committees, in order to bring the several sections into closer relationship. A summer tour again took place, with the sanction of the Council, a party of students numbering 14 visiting works and other places of engineering interest in Sweden between July 21st and 29th, 1911. Mr. H. G. Jenkins conducted the tour, and the Committee record their appreciation of his work and of the assistance rendered by Mr. A. V. Clayton to the hon. secretary, Mr. D. Betts. There will be no tour this year.

INSTITUTION OF ELECTRICAL ENGINEERS (SCOTTISH LOCAL SECTION).—The annual report of the Committee states that the Section has now completed the first session under its new designation, and with its area embracing the whole of Scotland. The Committee felt that the ordinary general meetings of the Section should be no longer confined to Glasgow, and decided to hold a certain number of these in Edinburgh, and, although the attendance has not been large, the meetings held in Edinburgh have been generally successful. The membership now amounts to 362, an increase of seven. The Council has accepted the Section's invitation to visit Glasgow during the summer. The meeting will take place in the middle of June, and will last for three days. The Committee took exception to the apparent intention of the Council to obtain ratification of its original draft of revised Articles at an extraordinary meeting which had been called for November 2nd. Subsequently the President explained to the Section the reasons which made revision necessary, and the Committee is of opinion that the final draft of the proposed revision, as now printed, is generally in accord with the views of the membership of the Section. The office-bearers for the session 1912-13, besides past-chairmen, will be as follows:—

Chairman.—Mr. William M'Whirter.
Vice-Chairmen.—Mr. James Lowson; Mr. T. Blackwood Murray.
Chairman of Students' Section.—Mr. W. W. Lackie.
Ordinary Members of Committee.—Mr. J. A. Robertson; Mr. T. C. Parsons; Mr. David A. Starr; Mr. John Ferguson; Mr. M. B. Field; Mr. J. K. Stothert; Mr. Wilfrid L. Spence; Mr. J. F. Neilson; Mr. J. H. Bunting.
Hon. Secretary and Treasurer.—Mr. James E. Sayers.

At the annual business meeting in Glasgow on the 15th inst., the report was adopted and the officers declared elected. A paper was then read by Mr. D. A. Starr on "Power generation and distribution in the Clyde Valley."

ILLUMINATING ENGINEERING SOCIETY.—The Report of the Council states that the membership now exceeds 340—an increase of 70 during the year—and comprises electrical engineers (32 per cent.), gas engineers (20 per cent.), professors and experts (14 per cent.), representatives of oil, acetylene and petrol-air-gas lighting (6 per cent.), oculists (10 per cent.), architects (5 per cent.), and miscellaneous interests (13 per cent.). The Society claims to have been successful in stimulating interest in illumination and in organising friendly discussions between representatives of rival modes of lighting. The Joint Committee on Street Lighting is still pursuing its labours, and other committees have been appointed to deal with the lighting of libraries and schools. The Society was formally recognised by the International Electrical Congress at Turin, which authorised it to form an International Commission to study all systems of lighting. Good work has been done in many other directions, including the teaching of illuminating engineering. The use of the term "illuminating engineer" is deprecated by the Society, and membership of it is not regarded as entitling members so to describe themselves.

In a lecture to the MANCHESTER LIT. AND PHIL. SOCIETY, on May 7th, Dr. Henry Wilde described his early work in the evolution of the dynamo-electric machine; he employed it for the operation of searchlights, which were adopted by the British Navy without payment. Afterwards the Mercantile Marine adopted the system; had it been in use on the *Titanic*, he said, that vessel would not have been lost.

Educational Notes.—On Saturday last Lord Haldane opened the new Harrison-Hughes Engineering Laboratories at Liverpool University, which have been erected at a cost of £40,000, given by Messrs. T. F. Harrison, J. W. Hughes and H. Harrison, shipowners, of Liverpool.

At the annual meeting of the BRITISH SCIENCE GUILD, held at the Institution of Electrical Engineers on Friday last, Sir W. Ramsay presided. He drew attention to the danger involved in a failure to obtain supplies of nitrates from abroad, which would prevent us from maintaining a supply of explosives in time of war, and he urged that the manufacture of nitrates from the air should be established in our colliery districts.

Appointments Vacant.—Assistant electrical engineer, for the East Indian Railway Co. (Rs. 450 per month); lecturer in physics and electrical engineering at the Belfast Municipal Technical Institute (£180). See our advertisement pages in this issue.

London Electricians' Trade Movement.—We have received the following report:—

"On Saturday last a general meeting of the London members of the Electrical Trades Union was held at Chandos Hall to consider methods to secure an improvement in the conditions of the various grades employed in the electrical industry. After an exhaustive discussion of the various points raised, it was unanimously agreed that—'This general meeting of London members of E.T.U. instructs the District Committee to formulate proposals embodying an increase of wages to 1s. per hour for electrical wiremen, and corresponding increases in other grades employed in the electrical industry. The hours of labour to be 48 per week, or in conformity with those prevailing in the building industry, as the case may be. The proposals to be submitted to the London Electrical Contractors' Association, London County Council, public bodies, and all others concerned at a date to be decided hereafter.'"

Recent Progress in the Manufacture of Incandescent Lamps.—Innumerable methods have been tried to avoid the great liability of tungsten filaments to fracture at the terminal connecting points; one of the most successful devices consists in mounting the central column on a short length of piano wire, but even then vertical shocks remain disastrous. Last year was marked by the commercial perfecting of the drawn-wire tungsten filament. Early failures to obtain satisfactory drawn tungsten have been attributed to the presence of traces of carbon, but experience shows that tungsten containing 0·005 per cent. of carbon is no more ductile than that containing 0·1 per cent.—nevertheless, elimination of carbon should be carried as far as practicable. Ductile tungsten, as used in drawn-wire lamps, may be considered chemically pure. Its strength, elasticity and ductility are comparable with those of steel. The original structure of the metal is fibrous, and drawn tungsten lamps may safely be handled as carelessly as carbon lamps *before they have been used* for any appreciable time. It appears, however, that the drawn wires develop an irregular crystalline structure in use, and must, therefore—for the present—be handled with the same care as the older squirted filaments when in service. Great care has to be paid in manufacture to the support of the filament and its connection with the leading-in wires.

A valuable property of ductile tungsten is the ease with which

it can be drawn into filaments of various C.P.; thus a given length of wire can as well be made into a 6-ampere as into a 0·2 ampere filament—further, the filament may be arranged in a loop, spiral or zig-zag, so as to yield any desired distribution of light. The number of contacts between the filament and its supports, including the terminal attachments, and the length of the filament control the robustness of the finished lamp.

Data showing the influence of the number of contact points and the relative merits of copper and molybdenum supports are appended :—

Number of contacts	11	13	15
Relative resistance to shock—Cu ...	91·5	100	96·5
" " " —Mo ...	91·5	100	93·0
Performance at normal efficiency—Cu	99·4	100	96·1
Relative life at max. temperature—Cu	107·0	100	87·0
" " " —Mo	107·0	100	103·0

—*L'Industrie Electrique.*

Scottish Tramway Managers' Association.—Mr. C. W. Shepherd, of the Edinburgh and District Tramway Co., presided over a meeting of this Association, held in Leith Council Chambers, last Friday. Among the subjects discussed was the question of the providing of vestibules or protected fronts for drivers on cars. Later in the day the delegates were entertained to luncheon by the Corporation and inspected the Leith electric tramway system.

Strike.—On the 10th inst. 40 members of the Electrical Trades Union engaged in wiring and fitting work, struck work, making a claim for an increase of ½d. per hour, to 9d. According to a Leicester paper, the strike was the result of a breakdown of negotiations which had been in progress for 18 months, conferences between the men and the Electrical Contractors' Association having been unsuccessful.

Parliamentary.—The Unapposed Bill Committee of the House of Commons has passed the preamble of the Penwortham Bridge Bill. The Bill authorises the abandonment of a portion of the authorised tramways of the Preston, Chorley and Horwich Tramways Co., and the construction of a new or substituted tramway over the bridge.

THIRD READING.—In the House of Commons on Monday, the London United Tramways Bill was read a third time.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—MR. J. K. HOLDEN, of Bradford, has been appointed assistant in the Brighton Corporation meter department.

MR. B. DRANE, late of the Sutton (Surrey) staff of the South Metropolitan Electric Tramways and Lighting Co., who has obtained a position in the Electricity Supply Department of Marylebone T.C., has been presented by his late colleagues with a demi-hunter watch bearing a monogram and inscription.

The Portsmouth T.C. has adopted a recommendation from the E.L. Committee forthwith to increase the salary of MR. W. S. FOALE, engineer and manager of the E.L. station, from £500 to £550 per annum.

The Swindon T.C. has increased the salary of MR. A. DIMMACK, the electrical and mechanical engineer, from £275 to £300 per annum.

On 16th inst., at the Wolverhampton Corporation electricity works, MR. ERNEST STUBBS, chief assistant engineer, was presented with an oak writing table to mark the occasion of his marriage to Miss D. Watkins, of Wolverhampton. Mr. Shawfield, Borough electrical engineer, made the presentation on behalf of the officials and employés of the department, and referred to the rapid growth of the undertaking during the 11 years of Mr. Stubbs' service, and the consequent increase of the latter's responsibility. Messrs Forder, Rothwell, Dudley, and Smith, also made congratulatory speeches.

MR. B. T. HAWKINS, late station superintendent at Wakefield electricity works, prior to his leaving to take up a similar position at St. Helens, was presented by the staff and workmen of the electricity and destructor department with a pewter flower épergne. Mr. Garside, commercial engineer, expressed the esteem of the employés for Mr. Hawkins. The presentation was made by Councillor England, chairman of the Electric Lighting Committee.

Tramway Officials.—The Swindon T.C. has increased the salary of MR. T. MEDCALF, tramway manager, from £200 to £225 per annum.

The salary of MR. A. WOOLSTENCROFT, tramways traffic superintendent to the Ilford U.D.C., is to be increased from £220 to £230 per annum.

General.—MR. W. D. WEAVER has just retired from the position of editor of the *Electrical World* (U.S.A.) which he has held for the past 19 years. He will devote himself to literary and other private pursuits and will act as consulting editor to the *Electrical World*. His journalistic and other friends gave a luncheon in his honour on April 29th at the Engineers' Club, New York.

The late staff of the National Telephone Co. at Brighton have presented a gold watch to Mr. P. F. HART, who has accepted an appointment at Buenos Ayres.

The King of Spain has conferred upon Mr. MARCONI the Grand Cross of the Order of Alfonso XII.

It is announced that the President of the Board of Trade has appointed MR. C. HAMILTON WICKES, who, as our readers know, is at present His Majesty's Trade Commissioner for Australia, to be His Majesty's Trade Commissioner for Canada, in place of MR. RICHARD GRIGG, who has received an important appointment under the Dominion Government. We have already made our readers familiar with the reports and views of both of these gentlemen respecting British trade prospects in the markets alluded to, and to both of them the ELECTRICAL REVIEW offers its congratulations. The British electrical and engineering industries will hope for still greater things at the hands of Mr. Grigg in the higher position which he will shortly occupy in Canada, while the experience and insight of Mr. Wickes brought to bear in the same country should assist us in our increasing efforts to substantially develop our trade connections in that more or less difficult market.

Obituary.—We regret to record the death, which occurred at his residence in London on May 16th, of MAJOR-GENERAL E. R. FESTING, C.B., F.R.S., late R.E., who was director of the Science Museum at the Victoria and Albert Museum from 1893 to 1904. Major-Gen. Festing was born in 1839. He became a lieutenant in the Royal Engineers in 1855, and served through the Central Indian Campaign between 1857 and 1859. In 1864 he joined the Department of Science and Art as Deputy-General Superintendent of South Kensington Museum.

The death recently occurred at Johannesburg of MR. DAVID LOWSON, electrician, son of the late Mr. Peter Lowson, Bridge of Earn. Mr. Lowson, who went out to Johannesburg in 1895, had charge of the installation work for many of the largest buildings in the town and suburbs, and was widely known and universally respected. During the Boer War he served in Thorneycroft's Mounted Infantry.

NEW COMPANIES REGISTERED.

Sheffield Electrical Engineering Co., Ltd. (121,834).—This company was registered on May 6th, with a capital of £3,000 in £1 shares, to take over the business of an electrical and mechanical engineer carried on by E. O. Burn, trading as the "Sheffield Electrical Engineering Co.," at 99, Rockingham Lane, Sheffield, and the business of general engineers carried on by W. Morton and E. Leadbeater Scott, as "E. L. Scott & Co.," at 109, Rockingham Lane, Sheffield. The subscribers (with one share each) are:—F. Kenyon, 47, Strathtay Road, Sheffield, gentleman; E. O. Burn, 136, Millhouses Lane, Sheffield, electrical engineer; Mrs. C. Kenyon, 47, Strathtay Road, Sheffield; R. B. Hodgson, 75, Riverdale Road, Sheffield, engineer; C. F. Bennett, 10, Figtree Lane, Sheffield, solicitor. Private company. The number of directors is not to be less than two or more than three: the first are F. Kenyon and E. O. Burn; E. O. Burn is permanent managing director, with £2 per week in addition to remuneration as an ordinary director; qualification, 50 ordinary shares; remuneration of ordinary directors £10 each per annum. Registered by C. Doubble, 14, Serjeant's Inn, E.C.

Standard Woodwork Co., Ltd. (121,836).—This company was registered on May 6th, with a capital of £15,000 in £1 shares, to carry on the business of manufacturers of and dealers in all kinds of accessories to telephones and telegraphs (especially switchboards, telephone bell cases and telephone battery cases), cabinet and box makers, wood workers and turners, &c. The subscribers are:—R. S. Challands, 19, Gayton Road, Hampstead, N.W., chartered accountant, 2,000 shares; C. H. Walton, 55, Fore Street, E.C., solicitor, 2,000 shares; A. P. Johnson, The Wong, Marsfield Gardens, S.W., solicitor, 1,500 shares; F. McDougall, 99, Aldersgate Street, E.C., merchant, 1,500 shares. Private company. The number of directors is not to be less than three or more than seven; the first are R. M. Jones, R. S. Challands, C. H. Walton, F. McDougall and A. P. Johnson; qualification, £250; remuneration, £50 each per annum. Registered office, 55, Fore Street, E.C.

Power Syndicate of South America, Ltd. (121,823).—This company was registered on May 6th, with a capital of £33,000 in £1 shares, to employ and equip expeditions, commissions, experts, and agents, to carry on the business of a power company to acquire water rights, to construct and operate power supply and other works, to supply and utilise water and water power, to carry on the business of mechanical, hydraulic and electrical engineers, &c. The subscribers (with one share each) are:—G. L. Bevan, 1, Cornhill, E.C., stockbroker; F. E. O. Tootal, 1, Cornhill, E.C., stockbroker; T. J. Fleming, 1,123, Talcahuano, Buenos Ayres, engineer. Private company. The first directors are G. L. Bevan, F. E. O. Tootal, and T. J. Fleming. Registered by Linklater, Addison & Brown, 2, Bond Court, Walbrook, E.C.

Anderson & Munro, Ltd. (8,247).—This company was registered in Edinburgh on May 7th, with a capital of £3,000 in £1 shares (2,000 preference), to acquire and carry on the business of Anderson & Munro, electrical engineers, 136, Bothwell Street, Glasgow. The subscribers (each with one share) are: T. B. Wright, 136, Bothwell Street, Glasgow, electrical engineer; A. S. Nairn, 136, Bothwell Street, Glasgow, electrical engineer. Private company. The number of directors is not to be less than two or more than five; the first are T. B. Wright and A. S. Nairn. Registered office, 136, Bothwell Street, Glasgow.

Rushmore Lamps, Ltd. (121,973).—This company was registered on May 13th, with a capital of £20,000 in 7,500 6 per cent. cumulative preference and 12,500 ordinary shares of £1 each, to take over the business carried on by a company of the same name, to carry on the business of manufacturers of, and dealers in, searchlights, lamps and all kinds of electric, gas, acetylene and other illuminating apparatus, and to adopt an agreement with the said old company, and G. H. Cobley, the liquidator thereof. The subscribers (with one preference share each) are:—S. F. Tyler, St. Lawrence, Thames Ditton, merchant; E. S. Kemshead, 12, Glasslyn Road, Crouch End, N., secretary. Private company. The number of directors is not to be less than two or more than seven; the subscribers are to appoint the first. Qualification, £100; remuneration, £100 each per annum (chairman, £150). Registered office, 46, Brewer Street, Piccadilly, W.

T. Harding Churton & Co., Ltd., (121,792).—This company was registered on May 3rd, with a capital of £10,000 in £10 shares (400 preference), to take over the business of an electrical engineer, carried on by T. H. Churton, at Atlas Works, Water Lane, Leeds, as T. Harding Churton and Co. The subscribers (with one share each) are:—T. H. Churton, 8, Hillary Place, Leeds, electrical engineer; S. H. Smith, Pengarn, Shaftesbury Avenue, Roundhay, Leeds, electrical engineer; Mrs. E. B. Churton, 8, Hillary Place, Leeds. Private company. The number of directors is not to be less than two or more than five; the first are T. H. Churton (permanent governing director; special qualification, £2,000 shares), S. H. Smith and one other to be nominated by the said T. H. Churton; qualification, £100; remuneration of T. H. Churton and S. H. Smith, £800 per annum divisible. Registered by Surr, Gribble, Nelson and Oliver, 6, Laurence Pountney Hill, E.C.

X.L. Electric Co., Ltd. (121,696).—This company was registered on April 29th, with a capital of £20,000 in £1 shares, to carry on the business of electricians, electrical and mechanical engineers, manufacturers of and dealers in electrical and mechanical devices, &c., to acquire the benefit of certain inventions for improvements relating to electrically-operated clocks and time-indicating devices, &c., and to adopt an agreement with L. J. Aron. The subscribers (with one share each) are:—R. C. E. Poulter, 71A, Queen Victoria Street, E.C., solicitor; C. T. Taylor, 71A, Queen Victoria Street, E.C., clerk. Private company. The number of directors is not to be less than two or more than five; the first are C. Weiner (chairman and managing director) and L. J. Aron. Registered by Bristows, Cooke & Carpmael, 1, Copthall Buildings, E.C.

Institute of Wireless Telegraphy, Ltd. (121,782).—This company was registered on May 3rd, with a capital of £2,000 in £1 shares, to take over the business of wireless telegraphy instructors carried on by the Manchester Institute of Wireless Telegraphy at 15, Market Street, Manchester, to carry on the business of contractors for wireless telegraph installations, &c. The subscribers (with one share each) are:—E. A. Mayne, 15, Market Street, Manchester, wireless expert; C. G. Marston, National Liberal Club, Whitehall Place, S.W., gentleman; G. A. Blount, 7, Ormond Road, Richmond, Surrey, gentleman. Private company. The number of directors is not to be less than three or more than seven; the first are E. A. Mayne, C. G. Marston and G. A. Blount; qualification, £100. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

CITY NOTES.

German Electrical Companies.

THE Deutsch-Sudamerikanische Telegraphen Gesellschaft, of Cologne, after making provision for depreciation, reports net profits and balance forward amounting to £49,000 in 1911, as compared with £43,000 in the previous year. The sum of £2,100 has been placed to the reserve fund, £7,500 to the contingency fund and £2,500 to the pension fund. Out of the balance it is intended to pay a dividend of 6 per cent. on a share capital of £350,000, being the same rate as in 1910, and at the rate of 6 per cent. on a share capital of £150,000 for a period of nine months. The cable maintenance fund received an allocation of £7,500 in the year 1910.

The first report of the Hochfrequenz-Maschinen A.G., of Berlin, which was formed some time ago for the working of the Goldschmidt patents for wireless telegraphy, states that two experimental generators were tested at the Lorenz Co.'s testing station at Eberswalde during 1911, and the favourable results had given occasion to trials on a large scale. It was intended for this purpose to erect a large station in Germany, and a second in the United States, which were to be carried out this year, and the unpaid capital was being called up to provide the necessary funds. The accounts show a debit balance of £7,800 on a share capital of £105,000, of which £45,000 was paid in 1911.

The Elektrizitats Lieferungs Gesellschaft, of Berlin, which carried on 28 electric supply works in 1911, realised gross profits of £207,000, as compared with £165,000 in the preceding year. After meeting general expenses and interest charges on loans, the decline in the value of securities has rendered it necessary to make provision for their depreciation to the amount of £37,000, this contrasting with £31,000 in 1910. The net profits and balance forward are returned at £124,000 as against £97,000, and it is proposed to pay a dividend of 11 per cent. on the old capital of £750,000 as compared with 10 per cent. in 1910, and 5½ per cent. on the new share capital of £250,000. It is now intended to make a fresh increase of £500,000 in the share capital to defray the expense of extending existing works and participating in new transactions.

The directors of Hartmann & Braun, A.G., of Frankfort-on-Main, state that the course of business in 1911 was good, all departments were fully occupied and the turnover showed a notable increase over the previous year. Nevertheless the severe competition in the whole of the electrical industry, which was emphasised in the report for 1910, had an unfavourable influence on sale prices last year. The gross profits amounted to £81,000, as against £74,000 in 1910, and the net profits, after setting aside £7,500 for depreciation as compared with £7,100, are £24,000, as contrasted with £21,000 in the previous year. A dividend of 10 per cent. is in contemplation on the share capital of £85,000, being the same rate as in 1910. The special reserve fund receives £2,000, the officials a bonus of £6,400, and other profit-sharing absorbs £5,600. It is proposed to raise a further loan of £25,000 for the purpose of providing additional working capital.

Manufacturing in Belgium.

THE directors of the Ateliers de Constructions Electriques, of Charleroi, announce in their annual report that the orders received in 1911 represented a value of £576,000, as compared with £480,000 in the preceding year. A constant increase took place in the number of regular customers, and most of the companies which had given initial orders continued to entrust the company with work notwithstanding the prevalence of keen competition. On the other hand, the efforts put forward by the technical staff in the examination of schemes submitted to the company had opened up new and important markets. The department for turbo-alternators constructed machines ranging from 2,000 H.P. to 12,000 H.P., whilst the lifting branch carried out special apparatus for foundries, blast furnaces, steel works and rolling mills, including casting cranes, furnace chargers, &c. As a result of various installations completed in previous years in the electrical driving of rolling mills, the company had obtained orders for apparatus of large power for delivery to different works, and several winding engines ordered in 1910 were put in operation last year. The cable factory was started at the beginning of 1911, the contracts booked exceeded expectations, and complete satisfaction was given by the high-tension cables which had been supplied for pressures up to 15,000 volts. The accounts show net profits of £35,000 on a share capital of £400,000, and a dividend of £1 8s. per share has been declared on the priority shares and 8s. per share on the ordinary shares.

The report of the A.E.G.-Union Electrique for 1911 states that there was an abundance of business in the Belgian market, both in regard to industrial transactions and to central stations and tramways. Under normal circumstances this situation of affairs should have caused an increase in prices, which had fallen to a low level, but, contrary to expectation, the advance did not take place. It was possible to secure a larger turnover in 1911, whilst at the same time the amount of orders brought over into the new year was greater than at the beginning of 1911. The profits realised were also as satisfactory as in the preceding year. Including the balance forward, the accounts exhibit net profits of £15,800 on a share capital of £140,000, and a dividend is proposed at the rate of 13s. 7d. per share.

Shanghai Electric Construction Co., Ltd.

THE sixth annual general meeting of the shareholders of the above company was held on Thursday last week at Basildon House, Moorgate Street, Sir Alfred Dent, K.C., M.G., in the chair.

In proposing the adoption of the report (see ELECTRICAL REVIEW, page 806), the CHAIRMAN said there had been a considerable improvement in net receipts during the year under review. The accounts showed a profit of £14,139, as compared with £7,584 for 1910, and, including the balance brought forward of £6,635, the balance of profit and loss account amounted to £20,774. This balance had been dealt with by placing £10,000 to a reserve for renewals, by writing off £7,473, the item which had appeared in their last two balance-sheets under the heading of general expenditure during construction to June 30th, 1908, and carrying forward the balance of £3,301. The expense ratio, which was 78¼ per cent. in 1910, and 71¼ per in 1911, had been further reduced from the returns so far received for 1912 to 68 per cent. The result for the first four months of this year showed a continuous expansion, the receipts being £22,635, against £17,370 for the first four months of 1911, or an increase of £5,265. Their operating profit for the same period, as nearly as they could estimate it, was £7,200, as against £4,200. If this improvement was maintained as expected, their net receipts for the year would show a large advance on the £14,000. There had been a large increase in passengers carried, the number being 27,257,250, as against 18,751,215 in 1910, and 11,772,715 in 1909. There was a 12 per cent. increase this year in the car-miles run, which amounted to 2,241,112, over their track of 25½ miles, and the number of passengers per car-mile worked out at 12·16, against 9·39 for 1910, and 5·95 for 1909. The expansion which had been going on for some time, would necessitate further capital expenditure, principally on additional motors, trailers, and feeder cables. This was now being taken in hand, and might cost them about £20,000, but as their revenue was largely increasing, they anticipated no difficulty in providing the money, and hoped to replace it later on by a further issue of capital sufficient to repay the bank loan and refund to the company's treasury the large sums spent on capital account, which under present circumstances had to be met out of revenue. Such an issue should release their profits for the payment of a dividend. They continued to suffer severely from the loss in exchange on converting the native coins, in which their fares were paid into Mexican dollars. This cost them £15,477 (equivalent to 4¾ per cent. on the capital) last year, against £13,578 in 1910, and constituted a feature which did not exist when the concession was originally granted them by the Municipal Council. Power expenses had gone up £1,000, and amounted to £11,270, owing to their increased consumption. The charge per unit to general consumers had lately been reduced, but the tramway was again excluded from similar benefit. The 5 per cent. royalty on gross receipts had yielded the ratepayers £2,913 in 1911, as against £2,389 in 1910, and they were still unable to get this royalty reduced to the same basis as Hong-Kong and Singapore, where only 5 per cent. on net receipts was payable to the local authorities. No charge for road maintenance was included by the council in their budget estimates for 1912, but an amendment to the estimates was carried at the meeting held on March 21 last re-imposing the charge from January 1st, 1912. They had lately been carrying passengers at the rate of over 35,000,000 per annum, and this number would be again increased when the new cars and trailers were put into commission.

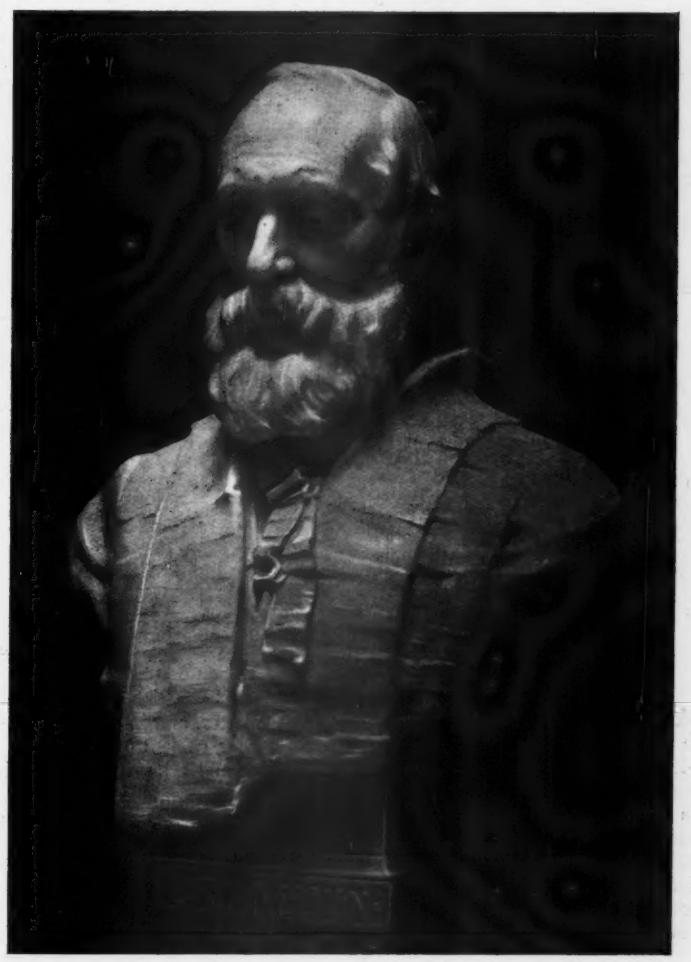
MR. J. S. HASKELL seconded the motion, and the report was adopted.

(*Continued on page* 849.)

PRESENTATION OF A BUST OF LORD KELVIN TO THE I.E.E.

On Thursday last week, in fulfilment of a promise made by Lady Kelvin, a marble bust of the late Lord Kelvin was formally presented to the Institution of Electrical Engineers. The ceremony took place in the course of the annual general meeting of the Institution, in the presence of a number of relatives of Lord and Lady Kelvin, amongst whom were included Mr. James Thomson, M.Inst.C.E. (nephew), Mr. F. Bottomley (nephew), Lady Hargreaves Brown (sister of Lady Kelvin), and Sir A. Hargreaves Brown. Dr. J. T. Bottomley, nephew and former colleague of Lord Kelvin, was unfortunately unable to attend, being absent from England.

The presentation was performed on behalf of Lady Kelvin by Sir W. H. Preece, F.R.S., with whom was associated Dr. S. P. Thompson, F.R.S. Sir William Preece remarked that that was the first occasion on which he had publicly visited the beautiful lecture hall of the Institution; he was probably the oldest living friend of the late past-president, as he knew him in 1861. He paid an eloquent tribute to the great scientific achievements and many excellent qualities of Lord Kelvin, who, he reminded the audience, had been President of the Institution on three different occasions (a triple honour which has been conferred upon no other, and which he bore at the time of his death), and he hoped they would treasure the almost living representation of him whom they had loved so well.



His mind, said the speaker, would ever be with us; his works were classic, and his memory immortal. He added that he would not rest content until he saw that bust accompanied by one of his earlier master—Faraday—and announced that he hoped to be able to present such a bust to the Institution at some future time. He then presented the bust to the Institution, in the name of Lady Kelvin.

Prof. S. P. Thompson said he had been asked by Lady Kelvin to express her regret at being unable to be present on that occasion. The bust, the work of Mr. A. M'Fadyean Shannan, A.R.S.A., of Glasgow, was a faithful representation of Lord Kelvin, executed by an artist who knew him personally and had already produced two other busts of him; in Dr. Thompson's opinion the third was an exceptionally fine one. Great as was Lord Kelvin as a mathematical physicist, he was, nevertheless, in the closest touch with the commercial applications of science; he had left it on record that the very life and soul of science depended upon the practical applications to which it could be put for the benefit of mankind. The Institution now possessed, in addition to that of Lord Kelvin, busts of Volta, Benjamin Franklin, Dr. John Hopkinson, Sir Francis Ronalds and Sir Charles Bright, as well as a medallion of Major-General Webber.

At the invitation of the President, Mr. James Thomson said a few words, and Mr. Ferranti then expressed his pleasure in accepting the bust on behalf of the Institution, with profound gratitude to Lady Kelvin.

We reproduce a photograph of the bust, which forms a most welcome addition to the art treasures of the Institution.

A short biography of Lord Kelvin, specially written for the International Electrotechnical Commission (of which he was the first president) by Dr. S. P. Thompson, has recently been published by that body in English and French, at a very low price, it having been felt that a great many people would be glad to possess a biography of one of the greatest men of modern times. The frontispiece is an excellent photogravure of Lord Kelvin, from a photograph which has not been previously published. That the biography is a masterpiece in its way need not be said to those who are familiar with previous works of Dr. Thompson, who, it will be remembered, was the author of the official biography of Lord Kelvin. Necessarily the matter is severely compressed, in order to bring so enormous a subject within the prescribed limits; but the result is to make the multiplicity and diversity of the great philosopher's labours even more strikingly apparent, by grouping them more closely together in a highly concentrated form.

We need not here recapitulate the many branches of science and industry of which the foundations were laid, or the practice revolutionised, by Lord Kelvin's inventions and discoveries; we will only quote one passage in his own words:—"There cannot be a greater mistake than that of looking superciliously upon practical applications of science. The life and soul of science is its practical application . . . many of the greatest advances that have been made from the beginning of the world to the present time have been made in the earnest desire to turn the knowledge of the properties of matter to some purpose useful to mankind." This was the great principle of which he was so distinguished an exponent—the principle which for a century has been regarded as the fundamental law of engineering.

G

THE DESSAU-BITTERFELD SINGLE-PHASE RAILWAY.

In the early part of 1911 there was opened one of the most important European railway electrifications so far under-

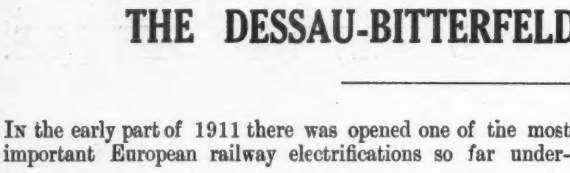


Fig. 1.—A.E.G. Express Locomotive and Train.

taken—the Dessau-Bitterfeld section of the German main line railways between Magdeburg, Leipzig and Halle.

The work was, to some extent, experimental, as it was necessary to prove the adaptability of electric traction on this section, which deals with all classes of railway traffic, and the Magdeburg-Leipzig-Halle lines were selected for electrification first of all, with a view to utilising the brown coal-fields in the Bitterfeld district, where a power station has been erected. The results of the operation up to now have demonstrated the usual advantages of electrification, such as higher speeds, quicker acceleration and ability to draw the heaviest trains.

The electrification is on the single-phase system with 10,000-volt 15-cycle current on the contact lines; the power station supplying the railway contains four Stirling and Garbe water-tube boilers, under which the brown coal is burnt on step grates.

The steam is superheated, and supplies a 3,750-K.V.A. 15-cycle turbo-alternator, by the A.E.G., generating single-phase energy at 3,000 volts pressure. Current is fed to two oil-cooled transformers, where the pressure is stepped up to 60,000 volts, and led to a sub-station at Bitterfeld over one overhead transmission and through two underground cables, the latter being the first examples of underground cables for this high pressure. The transmission distance is only about five miles, and the three transmissions were installed with a view to investigating the conditions which will arise when 60,000-volt pressures are a necessity.

The cables were supplied by the Felten-Guilleaume and Siemens-Schuckert companies, the former with copper and the latter aluminium cores, paper insulated and lead covered. Although delivering at 60,000 volts, the cable is only subjected to 30,000 volts, as two distinct single-conductor lead-covered grounded cables are used for the two conductors of each 60,000-volt single-phase circuit.

At the Bitterfeld sub-station the pressure is stepped down to contact-line voltage, 10,000, by two A.E.G. air-cooled transformers, each of 1,800 K.V.A.

The section of line between Dessau-Bitterfeld is about 27 km. long, and has six intermediate stations; it is double tracked throughout, and provided with a contact line constructed with ordinary catenary suspension, the vertical suspension points being at 6-m. intervals. The overhead work is carried on gantries spaced at 75-m. intervals, and the contact line is divided into 1,000-m. lengths, which are fixed at the centre and automatically stretched at the ends by hanging weights. This tightening applies to both the contact and messenger or suspending wires, and in order to ensure uniform tension of the messenger cable in all sections, a third so-called span-wire of similar material is stretched tightly between the supports of the latter, and in case of a rise in temperature, causing the messenger cable to expand, the span wire correspondingly expands and allows the suspension points of the messenger

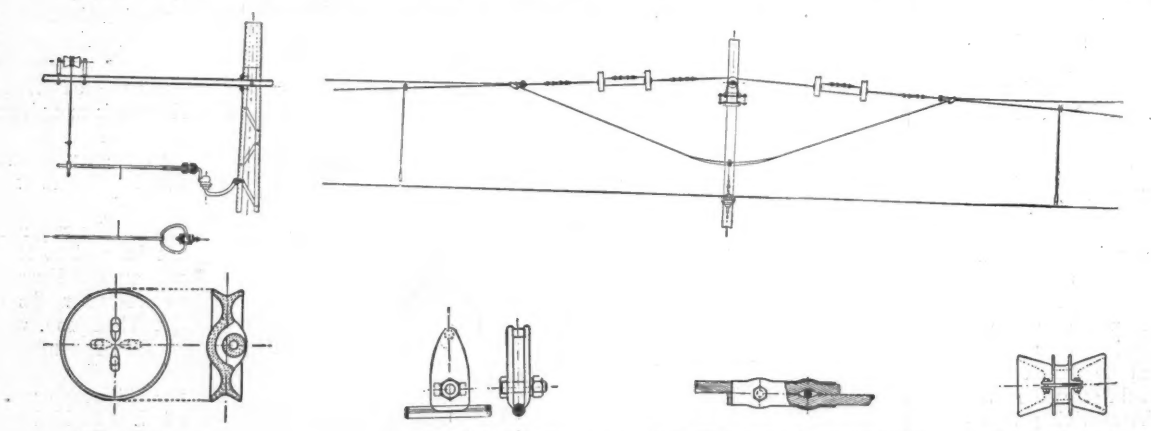


Fig. 2.—Showing Method of Suspension of Contact Line.

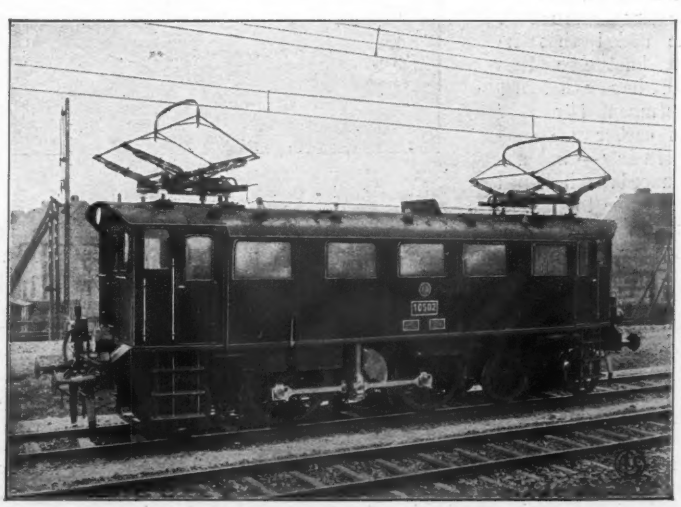


Fig. 3.—Single-Phase Passenger Locomotive, Dessau-Bitterfeld.

cable to move further apart, thus taking up the sag in the latter, and keeping the contact line nearly horizontal.

Fig. 2 shows the suspension of the contact line on a support. A "diabolo" insulator is mounted on the gantry so that it can rotate, and while the messenger cable and span wire are carried under the gantry without break, they are carried by a stranded wire support which runs freely over the diabolo insulator mentioned. Our view shows the system of clamping the messenger cable to the supporting wire on which disk insulators are fitted.

Stays of steel tubing are used for fixing the contact wires at the sides; the arrangement, which is shown in fig. 2, includes two insulators in series and provides a certain amount of play vertically and lengthways for the contact wire.

For ensuring uniform wear of the bow current collectors, the contact line is slightly zigzagged across the centre line of the track. The contact wire is of hard drawn copper, of circular section with side groves for the clamps; its sectional area is 110 sq. mm. for main lines, and 70 sq. mm. for sidings.

The messenger cable is seven stranded, of galvanised steel, and 42 sq. mm. in section; the span wire is a similar cable, but of only 20 sq. mm. section; the suspension wires are of galvanised steel, 3 mm. diameter, with a small loop at the bottom, allowing 5 cm. vertical movement of the contact wire, and the clamps for the latter are of pressed brass.

As regards the automatic tightening device, mention may be made of the method of proportioning the pull of the weight between the contact wire, messenger cable, and span wire, which consists in attaching them to a lever with unequal arms, the lever being held by the weight acting through a pulley system.

It will be noticed in fig. 5 that the last sections in each direction of contact wire, &c., overlap, and are, in fact, connected at the centre of the span, but in such a way as to allow of independent movement of the two sections. The track is sectioned in various places, the contact wires overlapping in the same way between two gantries, but not being joined. The arrangement of the contact line at a section division is shown in fig. 6; in such a case the two contact wires are connected to horn switches, which can be opened by a winch at the foot of the mast. Contact lines at small stations are connected to the main contact lines, except the loading track contact lines which are specially isolated and earthed for ordinary working, but switched in on request, in which case warning is given by a bell signal, and lamps which remain alight during the time pressure is on.

The rails are used as the return circuit, and are copper bonded in the usual way, and connected up at the sub-station by two heavily galvanised stranded copper cables; each main contact line is independently connected in the sub-station through an oil switch, and protected by roller-type lightning arresters arranged to operate at 15,000 volts. The contact line insulation has been perfectly satisfactory up to the present.

A service of express, ordinary, and a large number of freight trains, all for through traffic and drawn by locomotives, has been regularly conducted over the line, which,

Fig. 4.—Overhead Work; Entrance to Bitterfeld Station.

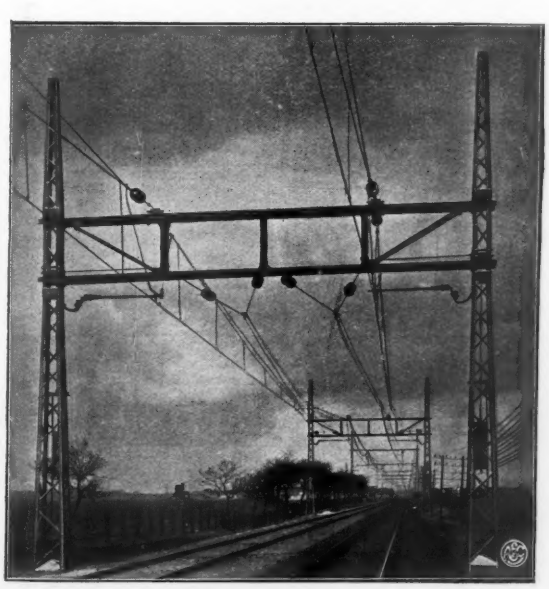


Fig. 5.—Automatic Tightening Device.

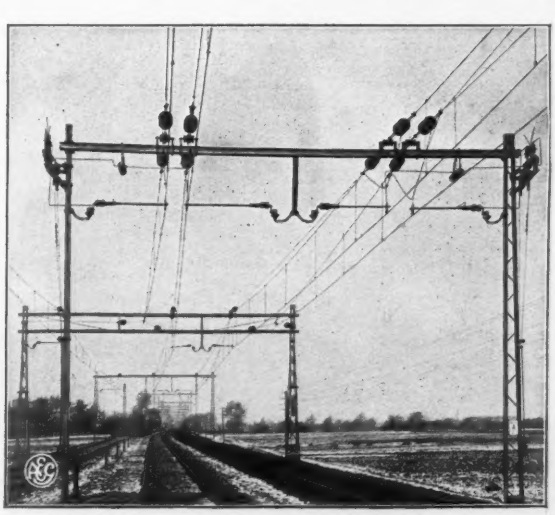


Fig. 6.—Section Division, Showing Horn Switches.

in addition, as was mentioned on page 122 of this volume, has been extensively used for trying the capabilities of various types of electric locomotives intended for single-phase working.

One passenger and one freight locomotive were provided by the A.E.G. in the first instance, and these have been in regular service for a year.

The passenger type of locomotive, intended for express and ordinary service, shown in fig. 3, was built for a speed of 110 km. per hour.

The axle arrangement follows the well-known Atlantic steam locomotive 4-4-2 arrangement—a leading 4-wheel bogie, two pairs of driving wheels worked by a parallel crank drive from a motor mounted high in the frame, and one trailing axle. The locomotive is 12,500 mm. long, with a fixed wheel base of 3,000 mm.

The 1,600-mm. driving wheels run at about 400 R.P.M. as a maximum, the speed being a safe one owing to the absence of reciprocating masses.

The motor—an A.C. commutator motor having an hourly rating of 1,000 H.P., and shown in fig. 9 in position in the locomotive—drives through vertical connecting rods on to a stiff intermediate crank-shaft midway between the two driving axles, the intermediate crankshaft driving on either side the usual coupling rods.

The vertical connecting rods are always at a dead centre when the coupling rods on the same side have to exert the maximum tractive effort, and the full driving power has to be transmitted by the intermediate crankshaft from one side to the other in these positions; this arrangement, however, facilitates the placing of the motor.

The intermediate shaft bearings are of special type, in view of the heavy strains, each being constructed in four parts, with all-round adjustments, and provided with a fusible plug, which, if melted by a warm bearing, blows an alarm whistle.

The rotor of the main motor has an axial play of 2½ mm. each side, and the motor is of the open type, to allow inspection of all parts. Ordinary contactor control is used; the current is taken from the overhead lines by means of two pantograph collectors, fitted with ball bearings. These collectors have removed earlier difficulties encountered with bow-type collectors, which proved unsuitable at high speeds, as it was not possible to counteract the effect of heavy wind pressure. The line current passes through a choking coil and main oil switch, and through the primary winding of the main transformer to earth; the secondary L.T. winding is provided with tappings, switched in by contactors, fig. 7, for varying the motor voltage as required for train working, and the circuit includes a reversing controller for reversing the main motor, also the armature and compensating windings. A static balancer is provided to adjust the voltage of the armature winding.

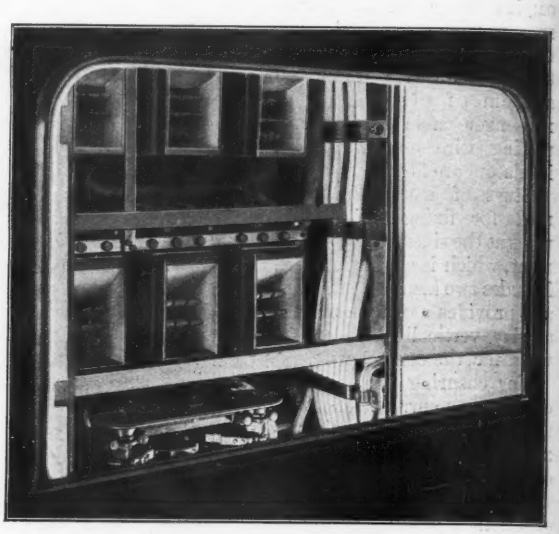


FIG. 7.—CONTACTOR CHAMBER.

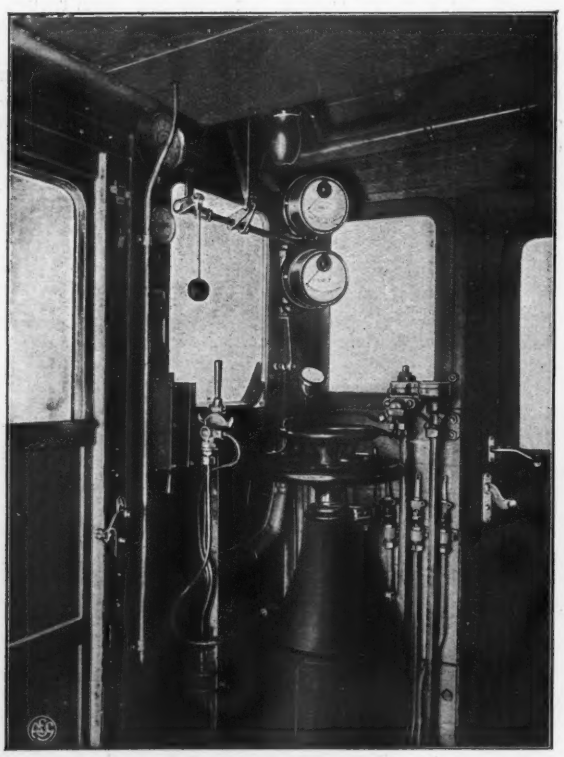


FIG. 8.—CONTROL GEAR, DRIVER'S CABIN.

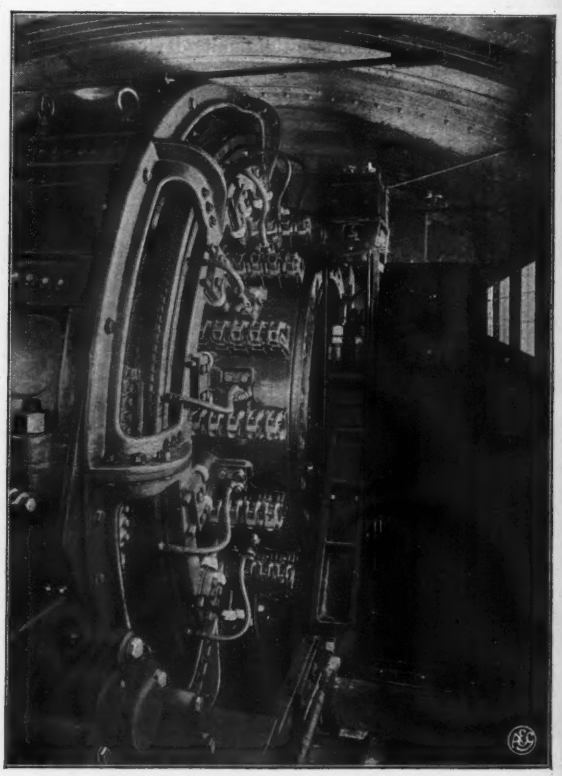


FIG. 9.—MOTOR COMPARTMENT, A.E.G. LOCOMOTIVE.

The transformer, erected in a compartment adjoining one of the driver's cabins, is specially ventilated; the main oil switch is mounted over it, with handles projecting into the cabin.

The contactor chamber adjoins the motor, and contains the master controller, while the reversing controller and a throw-over switch for short-circuiting the armature at starting (operated by a compressed-air cock in the driver's cabin) are placed under the contactor chamber.

The master-controller consists of two independent drums, the upper one operating the contactors by means of current from an auxiliary coil of the main transformer, and the lower one adjusting commutation. Both controller drums are worked mechanically by two hand wheels in either driver's cabin, fig. 8, the lower one having speeds marked on it.

Below the lower hand-wheel the lever of the reversing controller is shown, while over the wheel pillar are a small speed indicator, ammeter, voltmeter, air-brake pressure gauges, &c. The other apparatus controls the brakes, sanding, air pump, whistle, &c.

Fig. 1 shows one of the locomotives hauling an express train. Tests show a maximum tractive effort at starting of 9,500 kg., and the average starting acceleration with a train of 280 tons was ·19 m. per sec. per sec.; the maximum temperature of the motor on a lengthy test was found to be 70° C., with 20° C. external temperature.

The freight locomotive was constructed for a maximum speed of 70 km. per hour; it is mounted on four coupled driving axles with a motor drive through a central intermediate crankshaft very similar to the other locomotive. A maximum tractive effort of 10,000 kg. at driving wheel periphery is obtained. The main motor in this case is of 800 H.P. (hourly rating), and so placed with regard to the intermediate crankshaft that the driving rods are at 45° to the horizontal—this arrangement giving a more favourable distribution of strains on the intermediate shaft, which has cranks set at 90°.

The two locomotives are similar, electrically, in many points, but in this case a trial was made of the regulation of motor starting by shifting the brushes to one side or other of the zero position, according to the desired direction of travelling. This brush movement is by a screw and hand-wheel in the driver's cabin. Further regulation of the motor voltage is by means of a step transformer switched through a mechanically-operated controller.

In view of shunting work two similar hand-wheel pillars are provided, one at each side of each of the driver's cabins.

It may be interesting to refer to one or two other locomotives which have been tried on this route. One of these is intended either for express passenger or slow freight trains on the Lauban-Konigszelt line, and is carried on four coupled driving axles, with leading and trailing axles: two 900-H.P. motors (with the transformer between) are fitted, driving through connecting rods at 45° to the horizontal on to the usual intermediate crank-shaft.

The hourly rating is 1,600 H P. at 50 km. per hour, the highest speed 110 km., the maximum tractive effort 12,000 kg., and the total weight 99 tons. In view of experience gained during trials, air passages 500 mm. wide are provided on either side of the locomotive from end to end, and pass a strong current of air to the electrical apparatus. As the trains will be through ones and steam-heated, an electrical water-heater is also provided.

Another locomotive built for service on the French railways near the Pyrenees was subjected to an extended test. Two 800-H.P. motors are fitted, which in this case drive through inclined connecting rods on to two intermediate crank shafts, one at either end of the three driving axles, the coupling rods being extended; a trailing axle is also provided at either end, of the radial type.

Provision was made in the control of the locomotive, for the return of energy to the line on steep gradients which exist on the electrified sections of the French railway, and trials on the Dessau-Bitterfeld line made by drawing one locomotive by another, showed the success of this arrangement at medium speeds.

The locomotive drew 1,500 ton freight trains with ease at speeds of 40 km. per hour on 4 per cent. grades, and has proved very suitable for passenger service owing to its high accelerating qualities.

Another type of freight locomotive, one of 12 similar machines ordered from the A.E.G. for other railways has been tested, also other locomotives by Siemens-Schuckert, Bergmann, the Maffei Co., and Brown-Boveri as mentione in our issue of January 26th last.

As a result of the experience gained on the Dessau-Bitterfeld line, the Prussian Railway authorities have since commenced the electrification of the Magdeburg-Leipzig-Halle line, 170 km. and the Lauban-Konigszelt lines, 240 km. The former is expected to be working this year, and a pressure of 15,000 volts on the contact line will be adopted.

In conclusion, we are indebted to the A.E.G. for our illustrations; the various publications of the company have also been freely drawn on for information.

CITY NOTES.

(*Continued from page* 844.)

Eastern Telegraph Co., Ltd.

Sir John Wolfe Barry, K.C.B., chairman, presided over the meeting of this company at Electra House, E.C., on May 15th.

In moving the adoption of the report (see Electrical Review, page 764), the Chairman said that the gross revenue for the half-year amounted to £729,400, against £670,100, an increase of £59,300. Message and other receipts were £53,600 more than for the corresponding half-year of 1910, and the increased receipts were spread over practically the whole of the system with the exception of South Africa. Although the visit of the King to India, and also the war in Tripoli, had no doubt contributed to some extent to the improved revenue, the major portion of the increase in the traffic receipts appeared to be due to a general improvement in trade. The revenue for the whole year 1911 exceeded the revenue of any year since the inception of the company, and the improvement had been so far well maintained in the year now current. Turning to the expenditure side of the revenue account, the total expenses amounted to £282,800, while the expenses for the half-year to December, 1910, were £264,700. With an increase in the volume of traffic to be handled, they must look to a consequent general increase in their expenses all round. Expenses at stations were £24,000 more this half-year than for the corresponding period of 1910. Here, also, most of the items of expenditure show an increase when comparing the two half-years, as, in addition to the annual increments to the staff, they must expect some increase of expenses in view of the growth in the volume of work to be carried out consequent upon their growing revenue, especially when combined with their reductions in tariffs. In addition to this factor, they had found it necessary to improve substantially the conditions prevailing for the payment of overtime and Sunday duty throughout the system, and this revised scale had necessitated an increased expenditure of about £8,000 under the heading of salaries and wages. Maintenance of instruments showed an increase of £6,600, due to the introduction of new and improved apparatus for accelerating the speed, increasing the accuracy, and generally improving the working of the cables. The balance of the increase was spread over practically the whole of the items of expenditure comprised in this abstract. As a set-off against the increased expenditure referred to, the expenses attending maintenance of cables showed a reduction of £7,500 when comparing the two half-years. Although the actual expenses on this account were heavier this half-year, the amount received for the charter of their ships by foreign Governments and other telegraph companies was in excess of that credited for the half-year to December, 1910, so that the net total of the abstract showed a satisfactory reduction. As a result of the half-year's working, they had been able to make a contribution of £210,000 to the general reserve fund, while maintaining the payment of the usual dividend and bonus. The general reserve fund had been debited with £165,780 in respect of the new cable between Gibraltar and Alexandria, touching at Malta, which was successfully completed on April 12th. He referred to this matter at the last meeting, when he stated that the probable cost of this cable would be about £400,000. The above-mentioned figure of £165,780 represented the actual expenditure to December 31st last, and the balance of the cost would appear in the current half-year's accounts. The general reserve fund had also been debited with about £63,000 in respect of the partial renewal of some of their cables, and other special expenditure. It was, therefore, fortunate that they had been able to carry a substantial amount to the general reserve fund this half-year, and they looked forward to being able to contribute at least an equal sum next half-year so as to meet the balance of cost of these new sections, and at the same time maintain this fund as a provision against further expenditure for new cables, which would, no doubt, be necessary in the near future. From January 1st this year the company had been carrying deferred messages in plain language at half the ordinary tariffs. As the acceptance of this class of message had only been in operation for a few months, it was too early to form any definite opinion as to the effect this reduced rate would have upon the company's revenue

but their experience up to the present showed that apparently it had not adversely affected the ordinary fully paid traffic. They had also reduced the Press rates between Great Britain, South Africa, Egypt and the Straits Settlements to the low figure of 3½d. and 4½d. per word, and negotiations were in progress for reducing the Press rates for telegrams exchanged with India and other places in the Far East. Messages charged at these reduced rates were not subject to special deferment, it being the opinion of the company that it would be inadvisable to introduce any special deferment on Press messages beyond the ordinary regulation, which had always been in operation, that this class of traffic was transmitted when the line was clear. As regarded Australasia, the British Pacific Cable Board agreed to a deferred Press rate over their cable, but the Eastern and Associated Companies did not see their way to reduce their Press rate, as the Government cable was fully equal to carrying this description of traffic. They, however, agreed in case of interruption of the Pacific cable to carry this traffic as a temporary measure, so as to avoid the Press having to pay higher charges for their deferred news during such interruption. He thought they might congratulate themselves upon the continued prosperity of the Company. This feeling should also be shared by those who relied upon submarine cables for their important correspondence, because, as he had frequently stated at these meetings, their policy had always been to give the telegraphing public a fair share of the benefits which were derived from the success of their business. They fully recognised that, as public servants, they had a duty to perform to the public who supported them and the higher interests of the State must also be considered in all their dealings. Although their interests were to a great extent international, they could not forget that they were a British Company, and their efforts should always be directed towards endeavouring to maintain the good reputation which submarine cable enterprise in this country had deservedly acquired. They believed that the only way to keep in the forefront was to continue to improve the efficiency of their service. By this means, and by the granting of additional facilities whenever it was possible, they encouraged the desire to make greater use of their cables, which ultimately tended to increase their revenue and enabled them to reduce their rates whenever they saw a favourable opportunity of so doing. It must be borne in mind that, when important reductions in rates were contemplated, additional cables might be required to cope with the increased volume of traffic which might be created. Unless this important factor was carefully considered, they might find themselves incurring a serious liability for the cost of new cables which might be out of all proportion to the benefits to be derived from the increased volume of traffic at the lowered rates. This was a point which some people who were constantly agitating for further reductions in the rates could not, or would not, appreciate. It might be useful and interesting to compare some of the principal rates now ruling with those in vogue in 1876, when the introduction of the word-rate first took place :—

	Per word. 1876. £ s. d.	Per word. 1912. s. d.
Australia	0 10 6½	0
China	0 8 4	5
Japan	0 11 3	10
Straits Settlements	0 6 3	3 6
India	0 4 6	2 0
Egypt	0 1 7	1 0
South Africa (1879)	0 9 3	2 6
Gibraltar (1880)	0 0 6½	0 3
Peru (1875)	13 4	2 9
Chile (1875)	1 4	2 9
Argentine (1874)	(16 4	2 9
Brazil (1874)	18 7	2 7

The Press and telegraphing public might rest assured that whenever they felt justified in reducing their rates, it would be their policy to do so ; but naturally the interests of the stockholders and the interests of the public—which were really in common—must be safeguarded by taking into account the important points to which he had referred. They were convinced that by so doing the best interests of all concerned would thereby be protected.

SIR J. DENISON PENDER seconded the motion.

MR. STACEY said that six months ago he called the attention of the board to the question of co-partnership, and he hoped the board were giving the matter sympathetic consideration.

The CHAIRMAN said this matter of co-partnership was one which was being considered by a good many commercial firms, and personally he was sympathetic to the principle. It must be remembered, however, that cable companies were under rather special conditions in that the business was scattered all over the world. When, however, some of the great commercial firms had formulated something tangible, he thought the board would sympathetically consider it. At present they were not ready for it.

The report was adopted.

Hong-Kong Tramway Co., Ltd.

THE report of the directors states that the accounts to Dec. 31st show a profit of £14,361, which, with £8,557 brought forward, makes a total of £22,918 at the credit of the profit and loss account. The board have disposed of this amount as follows : Allocated to the reserve for depreciation and renewals, £9,000 ; charged to profit and loss account, to comply with the arrangement approved by the debenture-holders on July 11th, 1910, £10,000 ; carried forward, £3,918. The large increase in the net traffic receipts is caused partly through expansion of traffic (consequent on the revolution in China driving many refugees into Hong-Kong), but is principally accounted for by the fall in the discount in the copper subsidiary coinage. In this connection the directors notice with satisfaction that the Government of Hong-Kong introduced into the Legislative Council upon March 7th, 1912, a Bill to prohibit the importation and circulation of foreign copper and bronze coins, which, it is hoped, will further ameliorate the position. The working expenses for the year have been increased by £1,233, of which the greater portion was incurred under the heading of maintenance and repairs.

MR. E. C. MORGAN (chairman) presided on Thursday last week at the offices, 19, St. Swithin's Lane, over the ordinary general meeting of the above company.

In moving the adoption of the report, the CHAIRMAN said he would explain the wide difference in the figures of the accounts as shown compared with last year's accounts. The very great increase in the net receipts during 1911 was due mainly to the smaller sum which it had been necessary to provide for the loss on subsidiary coinage, viz., £5,000. This, as he had frequently had occasion to tell them, was a matter beyond the control of the directors. Apart from that, however, the gross receipts during 1911 had exceeded those in 1910 by over £2,000, and this was the best evidence that the popularity of the company continued to grow, which he was glad to say was the case to even a greater extent during the present year. They would also be pleased to notice that the Government were now seriously taking up the vexed question of the standard of the coinage, and it was to be hoped would arrive at a scheme which would render further reference to this disagreeable question unnecessary in the future. It would also be a subject for congratulation for the shareholders to observe from the accounts that the conditions imposed by the debenture-holders two years ago had now been fully complied with, and, in addition, that the substantial sum of £9,000 had been placed to reserve for depreciation and renewals, bringing that up to £30,000. The expenses of the year showed an increase of about £1,233, but this was largely due to the heavy amount expended on maintenance and repairs, and in a measure to the increase in the number of passengers carried and the miles run, which resulted in an increased rate of earning per car-mile, far in excess of the additional expenses, while the condition of the plant and track had been maintained in a high state of efficiency. They could notice an increase under the heading of salaries in Hong-Kong, which was due to the necessary changes in the staff, involving additional expenditure, but that was not likely to be recurrent. He thought he might safely say that the position of the company was thoroughly sound, and gave good promise of future improvement, as they were now in a position to meet the demands of the public for further developments as they arose, and they had an excellent staff, whose hearts were in their work. Before concluding, he would like to record a vote of thanks to Mr. Kennedy and his staff, to whose unstinted efforts the present favourable position was due.

MR. R. MILLER seconded the motion, which was carried.

The retiring directors having been re-elected, MR. MILLER moved the addition of Mr. A. C. Morgan to the board, and this was seconded by MR. CUTBILL.

MR. W. T. SHAW objected to an addition to the board, as the company was not paying any dividend, and there was no need to incur additional expense. He pointed out that the proportion of London expenses was not so great in the Calcutta Tramways Co., of which their chairman was also the chairman, as was the case in the Hong-Kong Co.

The CHAIRMAN said that the addition to the board would entail no additional expense, at least until a dividend was paid. The work of the company was increasing, and he would remind shareholders that the directors were not immortal. He had lately received a rather sharp reminder that he might be necessarily removed from the board, and it would be to the advantage of the company to have three directors left who were acquainted with all the business.

MR. SHAW withdrew his opposition, and the motion was carried.

A hearty vote of thanks to the staff concluded the meeting.

The Horsfall Destructor Co., Ltd.—The following notice has been issued to creditor debenture-holders, signed by Messrs. A. Barrett, H. C. Brodie and C. H. Cumberland :—

"The trustees have for some time been engaged in assisting the directors to bring the company into a more prosperous condition. At the moment when this had been accomplished, their efforts have been rendered futile by a decision in the Law Courts against the company in regard to materials supplied, and which is of so serious a nature that it has been found necessary to protect the various interests involved by applying for the appointment of a receiver and manager. The trustees greatly regret that the hope held out originally, that a reconstruction made possible the ultimate redemption of the creditor debentures, has not been realised, and that at present there is no prospect of any dividend."

Submarine Cables Trust.—The revenue for the year to April 15th amounted to £25,377, and the expenses to £1,315, leaving £24,061, plus £46 brought forward. After providing £17,235 to meet payment of the coupons, £6,798 has been transferred to the redemption fund, leaving £75 to be carried forward.

Urban Electric Supply Co., Ltd.

THE directors' report for the year ended December 31st, 1911, says that the gross profits amount to £50,876, as compared with £47,269 a year ago, and after deducting the expenses shown in the profit and loss account, a balance of £47,649 is carried down to net profit and loss account. In the latter account the amount required for interest and debenture redemption fund absorb £32,211, leaving an available balance of £15,438, which the directors recommend should be applied as follows:—To reserve for depreciation, £10,000; to dividend of 2 per cent. for the year on the preference shares, £5,000; balance to be carried forward £438. The balance of the 5 per cent. dividend on the preference shares will be satisfied by funded dividend certificates in accordance with the terms of the resolution passed and confirmed at the extraordinary general meetings of the company held on February 2nd and 17th, 1912. The usual comparative statement, showing the profits earned at the various works, and a table showing the equivalent in 33-watt lamps connected for three years is appended:—

	33-watt lamps connected.			Comparative statement of profit.		
	1909.	1910.	1911.	1909.	1910.	1911.
Hawick	44,725	57,681	65,599	£3,976	£4,771	£4,240
Stamford	32,573	33,563	32,411	1,532	1,626	1,467
Weybridge & Walton..	56,423	61,861	66,136	6,056	6,124	6,040
Godalming	27,549	29,612	32,971	3,406	2,982	3,396
Twickenham Co. ..	92,954	103,371	113,068	8,339	10,150	10,959
Dartmouth	23,478	23,734	24,543	2,586	2,607	2,637
Camborne and Redruth and Cornwall ..	69,698	75,041	105,178	7,920	7,620	8,727
Newton Abbot	16,509	18,570	20,719	1,452	1,467	1,695
Grantham	36,032	37,286	39,209	2,526	2,498	2,648
Glossop	26,141	27,588	28,782	2 999	2,641	2,983
Berwick	18,463	19,821	21,683	1,297	1,466	1,565
Caterham	12,665	14,813	16,563	950	1,142	1,635
Newbury	19,386	22,269	23,575	1,811	2,158	2,359
Totals	476,596	525,160	589,787	£44,850	£47,254	£50,850

Brisbane Electric Tramways Investment Co., Ltd.

ON May 21st Mr. H. R. Beeton presided at Winchester House, E.C. over an extraordinary general meeting of the above company, when the resolution passed on May 6th, with regard to paying a bonus to the shareholders in the form of new shares, was confirmed.

MR. BEETON subsequently presided at the eleventh annual meeting, and in moving the adoption of the report (see ELECTRICAL REVIEW, page 765), said it would be seen from the abstract of the Tramways Co.'s working for last year, that the total receipts for 1911 were £253,970, being an increase of £31,390, or 14 per cent., whilst the expenses showed an increase of £13,590, or 11·74 per cent. The net profit amounted to £124,686, being an increase of £17,800, and adding £2,908, the amount brought forward from 1910, the available balance amounted to £127,594, which had been appropriated in the following manner, namely: By payment of a dividend, free of income-tax, on the shares—all of which were owned by the Investment Co.—which absorbed £110,000; by placing £15,000 to renewals, raising that fund to £90,000; and by carrying forward £2,595. The passengers carried in 1911 were 36,443,222, being an increase on the previous year of 4,023,946, which was an advance of nearly 13 per cent. on the previous year, whilst the increase in car-miles run during the year was 147,902, or an advance of only 4·19 per cent. over the previous year. The business in the sale of power amounted to £7,355, an increase of £1,590, as against an increase of £950 in the previous year. Turning to the accounts of the Investment Co., the net proceeds of the dividend paid by the Tramways Co. amounted to £109,927; adding sundry receipts and the amount carried over from 1910, £3,589, and deducting therefrom London expenses and certain expenditure in Brisbane, £2,716, for which the Investment Co. was liable, they had an available balance of £110,800. The interest on the debenture stock, the dividends on the preference shares, and the usual 8 per cent. dividend, free of income-tax, on the ordinary shares, which was now recommended, absorbed £66,725, and there remained a balance amounting to £44,075. They proposed to appropriate £37,500 of this surplus in payment of a bonus of 10s. per ordinary share payable in shares, and to carry forward a balance of £6,575. They further recommended the payment of another 10s. per ordinary share out of the reserve fund. When these suggestions were carried into effect the Tramways Co. would have a renewal reserve fund of £90,000, and a balance carried forward of £2,595; whilst the Investment Co. would have a reserve fund of £4,500, an accident reserve fund of £3,000, premiums on debenture stock issued £500, and a balance carried forward of £6,575; so that the combined total of undivided profits amounted to £107,170, which, with some confidence, they regarded as ample for all contingencies. For some years past various sums had been expended on capital account without any fresh issue of debenture or share capital, the surplus funds being temporarily used for capital purposes. Thus, whilst the Investment Co.'s total debenture and share capital, including the £75,000 share capital about to be issued, would amount to £1,275,000, the outlay on capital account on December 31st last totalled £1,326,000, and this item would be increased by the cost of upwards of 6 miles of extensions now under construction, all of which, they believed, would become remunerative when open for traffic, and also by the corresponding new equipments now in progress. It was true that the Tramways Co. had investments valued at £47,000, but as this amount and more would be required to meet the expenditure for heavy renewals when it became necessary, they would in the near future have to issue further capital, which would probably take the form of the issue of ordinary shares at par. The various local authorities through whose districts the tramways ran had had several joint meetings with a view of coming to an arrangement for the purchase of the undertaking, culminating in their promoting a Bill in the Queensland Legislature seeking powers for the appointment of a joint board to negotiate with the Tramways Co. He was unable to say if these powers had been granted, but he rather thought that the Legislature was dissolved before the Act was passed, and they did not know exactly how the matter stood at the moment. The authorities had no power under the concession to purchase before 1921 except by agreement, and the fact was now generally recognised in Queensland that the basis of purchase must be the payment of the commercial value of the tramways as a going concern. Such negotiations as had occurred had been directed to enabling the authorities to acquire the undertaking now, or at any time prior to the expiry of the concession, at an agreed price and conceding a share of profits on the working in the meantime. Last year he predicted that under ordinary conditions a long period of prosperity might be looked forward to, and the operations of the past year had justified that anticipation. But he ventured also to say that the industrial position was not entirely free from anxiety, and he was sorry to say that since the opening of the current year they had suffered from a strike which had seriously affected them, which had vitally concerned the Commonwealth of Australia, and which had interested the world at large. The chairman proceeded to explain the working of the Wages Board in Queensland, under which, he said, their employés were as contented as any body of tramway men in Australia. In pursuance, however, of the policy of the Federal Government, against which there has since been a marked revulsion, a law had been passed, entitled "The Commonwealth Conciliation and Arbitration Act," which constituted a Court, for the same purpose as the State Wages Board, but consisting of one judge, who was bound by no rules of evidence, who was entitled to refuse legal assistance to either party on the objection of the other, who had jurisdiction in all industrial disputes extending beyond the limits of a State, and against whose award there was no appeal. The ground being thus prepared, it was not long before industrial war broke out. Agitators were sent up from Melbourne, who seduced a certain number of their men into registering themselves in a Federal Labour Union as contemplated by the Act, and, in conjunction with similar Unions in other States, engineered in the same way, extraordinary demands were embodied in a "plaint" which was forthwith presented for determination. Without, however, waiting for a decision of the Court, the agitators resolved to provoke a strike. To this end they resolved, on January 18th, that the members of the Federal Union in the company's employment should wear Union badges, in violation of a regulation of the company which had been promulgated in the previous May in order to avoid the intimidation and coercion of its employés. The recalitrants were interviewed by Mr. Badger, and as they insisted on their right to wear the badge, they were not allowed to board their cars. By availing themselves of the services of students who were under instruction for drivers, and of absent and retired employés who returned to work, they were able to continue a reduced service. Mr. Badger, who had acted throughout with the utmost moderation and firmness, won for the company the approval and confidence of the public from the first. The storm gathered in intensity and burst on January 30th, when a general strike of all trades was declared by a Junta, representing 43 Unions. The industrial crisis which followed this action was the worst in the history of Brisbane, if not in that of Australia. The Tramways Co. was the storm centre, and was the object of virulent attack. In these circumstances it redounded greatly to the credit of their general manager that, in spite of three futile attempts to blow up cars, no depredations on the company's property were committed, no injury to workmen ensued, no accidents occurred which were attributable to inexperience in driving, and what was even more gratifying, there were no defections on the part of their non-union employés, and they were now entirely free of the Federal Union. The history of the strike read like the account of a siege. Their depôt at Countess Street was surrounded with barbed wire entanglements and the live current turned on; they had a large number of men on guard well armed; the fire hose and the hot-water hose were both ready; and all the windows of the power station were protected with iron inside. Most of the men were quartered at the different depôts, and they established a provisioning department. Notwithstanding the fact that all the engineers except the chief, as well as most of the stokers, left suddenly, they were able to keep the power station running, which was of public importance for the reason that all the city and suburban railway stations and many other important institutions got their light from the company, and four times every day their whistle sounded its note of defiance. Thanks to the energy of the Queensland Government on February 2nd a sufficient force of special constables was organised to cope with the situation, and on February 5th they started some cars with a posse of police on each, amidst popular acclamation. Unfortunately the action of the Federal Judge in granting jurisdiction to the strikers and in summoning Mr. Badger to a compulsory conference in Melbourne on February 13th greatly protracted the strike. After three days' session, the conference came to nothing, and the judge immediately remitted the issue to his Court, where he affirmed the right to wear the badge, but was unable to compel the re-instatement of the discharged employees. In the meantime, all the vacancies having been filled, the men who went on strike while they received permission to wear their badges found themselves without work, and the company was accordingly placed in a position to plead in the "plaint" that it had no dispute, for the reason that no members of the claimant Association were in its employment, and that as they had a full staff, from engineers to

point boys, it was not necessary to employ any of them. The company had since obtained from the High Court a prohibitive injunction against the award pending the hearing of the principal suit, which they were hoping to defeat on the ground of jurisdiction. The company had, of course, suffered severely in traffic and in expenses caused by the strike, but they had been sustained by the approval of the entire community, excepting the Labour Unions, and with the resumption of normal conditions, which already obtained, they had hopes of recovering in the course of the year a large part of the loss. At any rate, they were encouraged in this anticipation by the traffic for April, which was a record return for that month. He regretted to say, however, that the health of Mr. Badger had suffered from the severe strain imposed upon him, and they had accorded him, on the advice of his physicians, a long leave of absence, upon which he hoped to enter in a few days. Mr. Badger was the pilot who weathered the storm, and it was the intention of the board before the close of the proceedings to propose a resolution of gratitude to him for his signal services. They had despatched their colleague, Mr. Hamilton, and the secretary (Mr. Woodrow), to Brisbane to take stock of the situation, and to make the best arrangements possible for filling his place until such time as he might be restored to health and the service of the company.

MR. CONCANNON seconded the motion, which was carried.

Subsequently, on the motion of the CHAIRMAN, seconded by SIR THOMAS ROBINSON (Agent-General of Queensland), a most cordial vote of thanks was passed to Mr. Badger for his devotion to the service of the company, and this was ordered to be cabled to him.

MR. WICKSTEAD also proposed a vote of thanks to the staff who remained loyal, and this was agreed to.

Delhi Electric Tramways and Lighting Co., Ltd.

THE sixth ordinary general meeting of the shareholders of the above company was held on Thursday last week at Basildon House, Moorgate Street, E.C., Col. Sir Buchanan Scott, K.C.I.E., presiding.

The CHAIRMAN, in moving the adoption of the report, said he was sure the shareholders would have been gratified to learn the announcement regarding the change of the capital of India from Calcutta to Delhi. This change would, no doubt, result in a great increase of business to the company, even so far as the existing area of its operations was concerned, and with a view to being prepared for future developments, the company had made a formal application to the Government for the extension of its area of operations. They would appreciate that the negotiations would inevitably occupy some time, so that, while the change had materially improved their prospects, they were not likely to derive much immediate benefit from the change. Turning to the figures in the report, he said he thought the shareholders would agree that the net result of the 14 months' operations might be considered satisfactory. The net revenue from the combined sections was £7,832, as compared with £3,232 for the 12 months ended October 31st, 1910. This increase was, of course, largely due to the additional revenue earned during the period of the Delhi Durbar. He was glad that the hope expressed at the last meeting with regard to the disappearance of the debit balance on the profit and loss account had been realised. After making good the whole of the accumulated loss, amounting to £1,912, they had an available balance of £1,401, which had been placed to the credit of renewals reserve account. The directors considered that necessary in order that the plant and equipment might be made more efficient, and they would now be able to carry out several alterations which had unfortunately to be left over in the past, owing to the company's financial position. The wiring and fittings department showed a profit of £272. On the debit side of the profit and loss account all the items showed an increase over the figures shown in the 1910 accounts. The increase under all heads was, of course, very largely explained by the fact that the accounts covered an additional period of two months. The net profit had amounted to £3,313, as compared with £457 in 1910. The passengers carried during the 14 months ending December 31st last numbered 2,957,456, as against 2,416,763 for the corresponding period. The receipts per passenger had amounted to '86d., as compared with '83d. The car-miles run totalled 437,429, as against 436,928, and the receipts per car-mile had risen from 4'59d. to 5'79d. The electricity portion of the business showed that for the period under review the units generated had amounted to 1,153,495, against 824,777, and the units sold to 498,657, as compared with 289,064. The average revenue per unit sold from all sources had been 5'4d., as compared with 5'1d. The consumers connected numbered 173, as compared with 203 in 1910, but the equivalent in 8-C.P. lamps had increased from 2,169 to 5,528. The total consumers connected at the end of last year was 685, and the total number of fans 865. The gross receipts from the tramway section since December, 1911, had been rather disappointing, but this was partly explained by reason of the fact that owing to certain alterations in the station a smaller number of cars had to be sent out. He was also inclined to think that they were suffering from an inevitable set-back following upon a period of prosperity. The receipts from the lighting section continued to increase, and they were constantly receiving further inquiries for supply of current for motive power, chiefly for small mills. They hoped to be able to expand that field of their operations very considerably in view of the expansion of local industry consequent upon the change of capitals. He hoped the shareholders would agree with him that the accounts showed that the company was now in a much more favourable position. They could not, unfortunately, have another Durbar this year, and he would ask the shareholders to bear that in mind when considering the figures for the later months of the present year, but with the additional growth of the lighting section, and the increased demands for power to which he had already referred, he felt sure that a considerable extension of the company's business was assured.

MR. T. W. STRATFORD-ANDREWS seconded the motion.

The CHAIRMAN, in reply to questions, said the attention of the board had been directed to the proposed Jumna power scheme, and they had been in negotiation with the promoters, who were very anxious that they should combine with them. They had told them that if they could give them a supply of power cheaper than they could generate for themselves, they would take it from them, but further than that they could not go. They could come in against them as competitors eventually if the Government gave them permission, but he did not think that a very likely contingency.

The report was adopted.

Rio de Janeiro Tramway, Light, and Power Co., Ltd.

THE report for 1911 records most satisfactory progress in all departments. The net revenue, after deducting all operating, maintenance, and other expenses in Rio de Janeiro, amounted to $6,781,006. The fixed and other charges of the subsidiary companies, and the fixed charges, interest, and general expenses of this company amounted to $3,072,411, leaving a surplus of $3,708,595. Four quarterly dividends of 1¼ per cent. each, amounting to $1,960,912, were declared and paid by the directors, and after providing for the sinking fund for the year on the first mortgage bonds—namely, $250,000—and transferring $300,000 to the general reserve fund, there remains $1,197,682, which has been added to the profit and loss account. The amount at the credit of profit and loss account now stands at $3,230,323. As an extension to its tramway system the company has acquired the Jacarepagua Tramway lines, a suburban tramway of 11 miles in length, extending from the terminus of the Cascadura line of the company. The line, which was formerly operated by animal traction, is being electrically equipped, and should prove a profitable undertaking, in addition to becoming a valuable feeder to the company's lines. In the past year there were built in the company's shops and added to the equipment of the tramway system 54 13-bench cars and 12 large freight cars, in addition to trailer cars, street sprinklers, and other miscellaneous equipment. The electric light and power service shows a steady growth. There are now installed transformers connected to the overhead and underground systems of 44,232-KW. capacity. Owing to the increase in the consumption of power, and in order to be in a position to cope with future requirements, it was deemed advisable to commence work at once on the tunnel and canal necessary for diverting the flood waters of the River Pirahy into the basin of the Rio das Lages. The diversion of this river will provide additional water capable of developing 50,000 H.P., and will enable the capacity of the power station at Rio das Lages to be increased to 100,000 H.P. when the growth of the business requires it. This work will be pushed to completion as rapidly as possible. The telephone business has shown satisfactory progress. On December 31st, 1911, 6,275 telephones were connected, as compared with 4,859 at 1910. These figures do not include the telephones of the Interurban Telephone Co., of Brazil, of which there were 721 on December 31st, 1911. The Interurban Telephone Co., of Brazil, was acquired by this company early in 1911, and its net revenue is included in the earnings of the telephone department. The Interurban is operating in the City of Nictheroy with long-distance lines to Petropolis and Rio de Janeiro, the latter by means of a submarine cable across the bay, connecting with the company's system. Other extensions are being made to important centres in the State, and this telephone system should prove a valuable acquisition to the company, and should add materially to the earnings of the telephone department. The telephone system in the city has also been extended considerably, and it is the intention to increase the switchboard capacity to 10,000 lines, in order to care for the growing demand for telephone service. During the year the company issued $2,375,000 par value of its capital stock, being the balance of the $40,000,000 authorised capital, and on December 8th, 1911, the shareholders in general meeting sanctioned the increase of the capital stock from $40,000,000 to $50,000,000. The company also issued during the year a further $1,000,000 of the English issue and Fs.12,580,000 (equivalent to £500,000) of the French issue of its 50-year mortgage bonds, bringing the combined English and French issues outstanding to £5,000,000. In the past year a subsidiary company, the Companhia Ferro-Carril do Jardim Botanico, successfully disposed of an issue of 5 per cent. bonds amounting to £1,200,000. This issue was mainly for the purpose of retiring an outstanding bond issue bearing 7 per cent. interest. A reduction of the subsidiary company's fixed charges for interest has therefore been accomplished, and at the same time additional capital of about £200,000 was provided for the development of its undertakings.

Stewarts & Lloyds, Ltd.—According to the *Financier*, the directors have decided to issue 212,500 deferred shares of £1 each. It has been decided to pay an interim dividend of 6d. per share (free of income-tax) on the existing deferred shares in respect of the half-year to June 30th, in order that the existing deferred shares may receive dividend to the date when the new shares begin to rank.

Mirrlees, Bickerton & Day, Ltd.—The directors have declared a dividend of 7½ per cent. on the ordinary shares for the year ended March £337 is carried forward.

Castner-Kellner Alkali Co., Ltd.—The directors have declared an interim dividend at the rate of 15 per cent. per annum for the half-year ended March 31st.

Chiswick Electricity Supply Corporation, Ltd.

THE directors' report for 1911 stated that the returns from the undertakings owned by the Corporation at Chiswick and Aberystwyth showed fair progress, and the number of consumers added during the year indicated a satisfactory increase. During the year £2,472 had been expended on capital account for machinery, mains, services, &c. An amount of £313 has been written off for depreciation, and it is proposed to place a further sum of £620 to depreciation reserve fund account, making a total contribution for the year in respect of depreciation of £933.

The figures below show the Corporation's liabilities on share and loan account at the end of four years:—

Year	1908.	1909.	1910.	1911.
On Shares	£62,800	£62,800	£62,800	£62,800
On Loans	£63,000	£80,000	£80,000	£80,000
Total	£125,800	£142,800	£142,800	£142,800

The following table shows the increase from year to year in the number of consumers, the revenue yielded and the profits distributed:—

	Consumers.	Revenue.	Profits.
1908 ..	1,693	£14,867	£6,834
1909 ..	1,875	£15,129	£7,592
1910 ..	2,081	£15,404	£7,5?4
1911 ..	2,287	£16,338	£7,363

The profits made by the Corporation for the year after paying sinking fund premium and trustees' fees were £7,363. Out of this sum interest on first mortgage debenture stock amounting to £3,600 had been paid, leaving a balance of £3,763 to the credit of the net revenue account. The increase in the revenue for the year amounted to £934, but the profits had not benefited by the increase, for several reasons. As in the previous year, the account for repairs had been heavy and included several exceptional items consequent on alterations to buildings and exchange of land at Aberystwyth, also an item in respect of reconstructing the chimney stack there. The item of rents, rates and taxes had increased by over £350, mainly due to an increase in the rates at Chiswick. Outlays incidental to opening the new showrooms at Chiswick, and certain other expenses, together with the increase in the amount written off for depreciation, disposed of the remainder of the £934 increase in the revenue, with the result that there was carried to the net revenue account £37 less than in the previous year. The results of the year's working, after placing to depreciation reserve fund account the sum above mentioned, would enable a dividend of 5 per cent. for the year to be paid on the shares of the company. The directors proposed that this dividend be paid to the West London and Provincial Electric Supply Co., Ltd., on May 15th.

West India and Panama Telegraph Co., Ltd.

THE directors' report for the six months ended December 31st, 1911, states that the amount to credit of revenue is £40,604, against £40,306, and the expenses have been £26,920, against £24,319. The result is, therefore, a balance of £13,683, plus £1,695 interest on investments, and £2,825 brought forward, making an available total of £18,204. The directors recommend, after paying first and second preference dividend, a dividend on the ordinary shares of 1s. per share (free of income-tax), requiring £4,416, carrying forward £2,018. The traffic receipts showed an increase of £1,833. The expenses of repairing cables (after deducting the amount mentioned in the next paragraph) amount to £9,103, as compared with £7,620. During the half-year the company's repairing steamer, *Henry Holmes*, was thoroughly overhauled in accordance with Lloyds' requirements for her No. 2 survey. The cost, £1,361, has been charged to reserve for depreciation. In January a contract was entered into with the Telegraph Construction and Maintenance Co. for the manufacture of 109 knots of cable for stock, which have since been delivered in the West Indies. The exclusive rights conferred under the Spanish concession for landing cables in Porto Rico expired on February 15th, and the United States Government has not acceded to the company's application for an extension of those exclusive rights. The company will, however, continue to carry on its business in that island.

MR. W. B. KINGSFORD (chairman) presided on Wednesday, May 15th, at Winchester House, E.C., over the meeting of the company. He said that the total revenue for the half-year was slightly more than it was for the same period last year. Their expenses were £2,600 more, mainly owing to maintenance of cables and landlines. The traffic receipts for the half-year were £1,833 more than they were in the corresponding period; but as against that, they had to spend in new cable £1,100 more than they did a year ago. The half-year's profit was £13,683, which, with the balance brought forward from last year and other items, made up an available total of £18,203, which the board proposed to deal with in the manner stated in the report. During the half-year they had increased their investments from £80,867 to £87,672. They would have seen by the report that their exclusive rights in the Spanish concession for landlines in Porto Rico expired on February 15th. The concession was granted them by the Spanish Government for a period of 40 years, and it was stipulated that during that period no other concession could be granted for the establishment of cables between Porto Rico and Cuba, and it was also stipulated that when the concession expired the company should still have the right to carry on business as before. After the Spanish-American war came to an end, and Porto Rico was taken over by the Americans in 1899, the company continued to carry on their business under the terms of the concession, and the United States Government had always most scrupulously respected their exclusive rights. With the view of obtaining an extension of their concession he went to Washington last June to submit the matter to the United States Government for its favourable consideration. Amongst those with whom he had interviews on the subject was the Secretary for War, whose department had charge of Porto Rico affairs. He told him that another company was in negotiation for landing cables in Porto Rico, and at his request he (the chairman) sent him for his information a long statement of their case, setting out fully the grounds on which they asked for an extension of their exclusive concession. As they were well aware, for some years the tendency of American policy had been to discourage strongly the grant of any kind of monopoly, and, as stated in the report, the United States Government had not acceded to their application. The question therefore of competition remained in their hands. He might mention that in connection with their negotiations they reduced the rate for the handling of a certain class of traffic. Recently, from time to time, statements had appeared in the newspapers, to the effect that Americans were purchasing their ordinary shares, and that to this cause chiefly was attributable the rise in the price of those shares. The board had repeatedly officially denied the truth of those statements, and he took that opportunity of emphatically confirming those denials. They had on the register 2,200 shareholders, of whom four only resided in America; those four had been on their books for periods varying from 22 to 35 years, and they held between them 635 ordinary shares all told. So far from large blocks of ordinary shares having been purchased with the view of obtaining the control of the company, of late there had been a noticeable increase in the number of their shareholders whose holdings were small. There were, therefore, no indications whatever in support of the statements to which he had referred. The traffic receipts for the current half-year showed a slight decrease. He thought, however, it was generally agreed that business in the West Indies was doing well, and that it showed a steady tendency to do better.

MR. H. HOLMES, in seconding the motion, said the statements which had gone about had done a great deal of injury, and had induced people to buy shares who had no knowledge of the past history of the company. People had bought shares at inflated prices.

MR. BIRKS said that amongst the statements which had been made was that the company would greatly benefit by the opening of the Panama Canal in respect of the land they held there, whilst another paper, commenting on the question of control, said that the balance of voting power had been vested for many years past in one of the organisations formed to finance the cable industry.

The CHAIRMAN said the company held no land in Panama, and knew nothing of anyone holding any control of the company. Such a statement was absolutely devoid of fact.

The report was adopted, and the meeting closed with a vote of thanks to the board and staff, on the motion of MR. BIRKS.

Western Telegraph Co., Ltd.

THE meeting of this company was held on Wednesday last week at Electra House, Sir J. Wolfe Barry presiding.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW, page 764), said that no exceptional political or commercial circumstances had occurred in any of the South American countries which were served by the company. The recent history of those States was one of steady development of the vast resources with which most of those lands were endowed, resulting in much progress in business, which was reflected in increased demands on their cable system. The company thus transmitted an increased number of messages in the six months under consideration, but the revenue therefrom was practically the same as for the corresponding six months of 1910. The explanation of this was that a lower tariff was in force during the latter half of 1911. With regard to this year, during the four months ended April 30th there was a satisfactory increase in revenue, but on 1st inst. the board decided that it was time that the international tariffs with South America should be further reduced by 10d. per word, and, of course, they could not yet see the outcome of this reduction. It was one which must be a great boon to all concerned in the future of the great countries which they served. The total reductions of tariff made since the first half of 1910 would amount to 1s. 5d. per word. With reference to the expenses for the half-year ended December last, those in London showed a net increase of £258, and at the stations and agencies an increase of £13,234. The principal item in this latter amount was an increase of over £6,000 in salaries and wages, due to annual promotions, and an increase of 40 in the number of the staff—viz., four Europeans and 36 Brazilians and Argentines. The cost of agencies was more by £740. Rent, taxes, &c., showed an increase of £1,078, principally in respect of Buenos Ayres and the Azores. The maintenance of landlines, electrical instruments, &c., was more by £915. Under the head of repairs and renewal of furniture were included some exceptional items, viz, refrigerating apparatus for St. Vincent, outside drum clocks for six stations, and pneumatic tubes for two stations. These accounted for the increase of £840. The advertising account was increased by £347. Legal expenses were higher by £2,573 in consequence of the lawsuit to which he referred at the last meeting. Expenses of training the staff were decreased by £655. Amongst the other expenses, staff assurance and pension funds showed an increase of £133, electrical and other technical departments an increase of £518, and cost of landlines occasioned by the removal of the landing place of their seven cables at Pernambuco was increased during the half-year by £4,490. The work being only recently completed, there would be a further additional charge for this

alteration of the cables in the current half-year. This expenditure was necessitated by harbour improvements which were being carried out by the State, and they hoped to obtain compensation for the expense which the company had had to incur. Interest on loans during the corresponding period of 1910 amounted to £1,269, but there was no charge under this head in the half-year under review. The ships and expenses attending the maintenance of cables showed a net decrease of £21,930, as compared with 1910, when a repairing ship was chartered at a cost of £18,000 to relieve the *Norseman*, which had to come home for survey and repairs. After providing £16,373 for debenture stock interest, and £7,874 for income-tax, there remained a balance of £248,302; to this was added £4,390, brought forward from June 30th last, making a total of £252,691. First and second interim dividends, amounting to £62,379, had been paid, and after transferring £150,000 to the reserve fund, and £10,000 to the land and buildings depreciation fund, there remained a balance of £30,312, which was carried forward.

Sir J. Denison Pender (deputy chairman) seconded the motion, and the report was adopted.

West London and Provincial Electric Supply Co., Ltd.

Sir T. Brooke Hitching presided at the offices, 14, Ironmonger Lane, E.C., on May 15th, over the twelfth ordinary general meeting of the above company.

In moving the adoption of the report, the Chairman said all the shareholders had received the reports of both the West London and Provincial Electric Supply Co. and of the Chiswick Electricity Supply Corporation. All the shares of the latter company were held by the West London and Provincial Co. By a reference to the Chiswick accounts (see p. 853) they would see a tabulated statement showing the profits, the number of consumers, and the revenue for the past 12 years. They would see that so far as the consumers were concerned every year had shown an increase, and the same thing applied to revenue. With regard to profits, that was the first year in which the profits were slightly smaller than in the preceding year. The diminution was less than £200, and was accounted for by the fact that there had been several exceptional items of expenditure consequent on alterations to buildings, exchange of land at Aberystwyth and the construction of a chimney stack there. He was sorry to inform them that the item of rates and taxes had increased by about £350 at Chiswick. There were certain other expenses they did not have in the preceding year, and had it not been for these there would have been a fair increase in the profits. This year the directors felt it incumbent upon them to make provision for a larger sum for depreciation, although he believed the machinery and works were kept up to the highest point of perfection. On that account the Chiswick Co. had allocated a smaller sum to the West London Co. This would permit of them paying the cumulative preference dividend of 6 per cent., but they were not able this year to pay the interest on the 4½ per cent. funding certificates. As these certificates were, however, cumulative, the shareholders must look upon that as a pleasure deferred.

Mr. W. B Esson, managing director, seconded the motion.

A Shareholder asked whether the National Welsh Museum at Aberystwyth would not tend to increase the revenue of the company?

The Chairman said the returns from Aberystwyth were a little up that year, and they hoped to find them increase. It would, of course, be some time before the Museum was completed. The Government and other people were spending a good deal of money in Aberystwyth, which he hoped would result in their undertaking there showing an improved profit in future. There had been some negotiations for the sale of the undertaking at Aberystwyth, but he was not in a position to say yet whether they were likely to come to anything. He thought Aberystwyth was a place of considerable promise.

The report was adopted.

West African Telegraph Co., Ltd.

Sir John Denison Pender, K.C.M.G., presided on May 15th, at Electric House, E.C., at the meeting of this company. In moving the adoption of the report (see Elec. Rev., page 765), he said that the total revenue was £54,932, compared with £61,797 in 1910, but this difference was accounted for by the Portuguese guarantee having come to an end in September last. The loss of traffic had to a certain extent been modified by an item of £1,539 to the credit of the loss on exchange account, for £1,539 interest and dividend on the reserve fund, so the actual loss on revenue account was £6,875. As regarded the expenditure in 1911, it was £26,051, against £20,923 in 1910, an increase of £5,128, but this was chiefly owing to repairs to cables. During the year there were light repairs which entailed an average of about 10 knots of new cable being put in at each repair. There was also the bonus to the staff in commemoration of King George's accession, which cost something like £500. The only item of interest with regard to traffic, was that they had instituted a half-rate plain-language traffic. It was not brought in really for the merchants, or for commercial work, because their codes were so good that they could get a much greater benefit than by a half-rate plain-language rate. It was felt, however, that there might be what he might term a class of social traffic—people wishing to send plain-language messages to their relatives, and so on. He thought the Portuguese subsidy wanted some explanation. Ever since the institution of the company the Portuguese Government had given them a subsidy, but this came to an end in September last, and now the company received nothing from Portugal. Of course the directors had been looking forward to this for a considerable time, and they had put a substantial amount to reserve. The subsidy amounted in 1910 to £21,121, and in 1911, when it only ran for part of the year, it came to £11,545. He thought the provision they had made for the future would not only prevent any diminution of dividend, but they would also be able to put a considerable amount to reserve fund, although not so much as in the past. Therefore, he did not think there was any possibility whatever of the dividend being reduced. The reserve fund now stood at the big figure of £284,392, as they had added about £16,000 since 1910. They proposed to pay the usual dividend of 4 per cent.

Sir H. C. Mance seconded the motion, and the report was adopted.

Swiss Electrical Companies.

The Société Financière pour Entreprises Electriques aux Etats-Unis, of Geneva, realised net profits of £15,200 on its investments in electrical undertakings in the United States in 1911, this sum comparing with £6,000 in the previous year. A dividend of 6 per cent. has been declared as against no distribution in 1910.

The Société Franco-Suisse pour l'Industrie Electrique, of Geneva, which is interested in many tramway and lighting and power stations, reports net profits and balance forward amounting to £52,000 for 1911, as contrasted with £43,000 in the preceding year. After placing £4,700 to the reserve fund a dividend of 4½ per cent. has been declared as against 4 per cent. in 1910. The value of the securities in portfolio and of other investments is returned at £1,670,000, whilst advances and other debtors represent a further sum of £560,000.

The directors of the *Société Métallurgique des Procédés Paul Girod*, of Neuenburg, intend to recommend at the forthcoming meeting that the ordinary share capital should be reduced by one half and then increased by a corresponding amount by the issue of preference shares. Since 1905, when a dividend of 7½ per cent. was paid, no distribution has been made on the share capital, which was fixed at £72,000 on the formation of the company in 1903, and has been gradually increased to £480,000. It is stated that the technical results obtained by the undertaking are favourable.

The Schweizerische Gesellschaft fur Elektrische Industrie, of Basle, which is an investment and trust company closely associated with the Siemens & Halske Co., states that all the undertakings under its control experienced a satisfactory development in 1911. As net profits the accounts, after deducting interest on the loan capital of £1,200,000, show the sum of £51,000, as compared with £48,000 in 1910. A dividend at the rate of 7 per cent. has been approved on the ordinary share capital of £400,000, this being the same rate as in 1910, whilst the new shares of £400,000 participate in the distribution at the same rate for six months.

French and Italian Thomson-Houston Companies.—The report of the Compagnie Francaise Thomson-Houston states that the yield from investments and technical working and subsidiary receipts amounted to £274,000 in 1911, as contrasted with £273,000 in the previous year. After making provision for general expenses and interest on loans, the accounts exhibit a net surplus of £153,000, as against £154,000 in 1910. It is proposed to pay a dividend of £1 5s. per share, as compared with £1 4s. in 1910 on a share capital of £2,400,000, the slight increase being rendered possible owing to the legal reserve fund having already reached the maximum of 10 per cent. of the capital. The directors of the A.E.G.-Thomson-Houston, of Milan, report an advance in the turnover of 1911, notwithstanding the unfavourable situation of the industry. The new works in Milan were in full operation, and produced a considerable portion of the machinery sold. The traction department completed the single-phase railway between Naples and Piedimonte, which, at a working pressure of 11,000 volts, represents the highest tension of a contact railway in Italy. After writing off £6,000 for depreciation, as in the preceding year, the accounts indicate net profits of £23,000, as against £19,000, and a dividend is in contemplation at the rate of 6 per cent. on share capital of £360,000, being the same as in 1910. It appears that the company, in addition to having become associated with the Berlin A.E.G. some time ago, has now acquired the shares of the Italian Lahmeyer Co., which has gone into liquidation, and has taken over that company's business.

Continental.—Germany.—The German-South American Telegraph Co., of Cologne, reports a net profit of £49,359 for the last financial year, as compared with only £43,808 in the preceding 12 months. The dividend is being maintained at 6 per cent.

The balance-sheet of the Felten & Guilleaume Carlswerk Gesellschaft, of Mulheim, for the last financial year, shows a net profit of £212,276, as compared with £142,055 in the preceding 12 months. The dividend is being increased from 4 per cent. to 6 per cent.

France.—La Compagnie Continentale Edison, of Paris, reports a net profit of £152,455 for the last financial year, as compared with £134,708 in the preceding 12 months.

Belgium.—The Société des Accumulateurs Tudor, of Brussels, reports a profit of £8,026 for the last financial year.

Hobart Electric Tramway Co., Ltd.—A further dividend is announced of 5 per cent. on the shares, making 7½ per cent. for the year.

Prospectuses.—*The Nagpur Electric Light and Power Co., Ltd.*—We have received a copy of the prospectus of this company, which was circulated in India in March, offering for subscription 20,000 shares of Rs. 25 each, with 4 per cent. per annum dividend guaranteed by the Municipal Committee of Nagpur for seven years from the completion of the installation by the contractors. It is stipulated, however, that if during that period profits are earned sufficient to justify the declaration of a dividend in excess of 6 per cent. per annum, one-half of the excess profits shall be paid to the municipality. The chairman of the directors is Divan Bahadur Sir Kasturchand Daga, K.C.I.E., and the whole of the eight other directors are natives of India. Messrs Crompton and Co., Ltd., of Chelmsford and Bombay, are engineers and contractors for the construction. Arrangements have been made for the lighting of 17½ miles of streets with 600 lamps, each of 30 to 40 C.P., for the annual sum of Rs. 11,000. Messrs. Crompton have contracted to erect the generating station, complete with mains, &c., for Rs. 315,875, and, if required, they will run the station on terms to be arranged.

The Rose Automatic Target Co., Ltd.—We have received a copy of the prospectus in which this company offers for subscription 19,000 shares of £1 each. The nominal capital is £35,000. The inventor and vendor is to take as his purchase price £4,000 in cash and £16,000 in fully-paid shares, and he will pay the preliminary expenses (about £1,000). The object of the company is to purchase the British and Colonial patent rights of S. A. M. Rose in the Rose electric recording target, with which our readers are already familiar. The British patent is No. 2,708, of 1908. A suitable factory building near London is under consideration, and it is proposed that Mr. Rose shall be technical adviser to the company and manager of its factory for two years. It is stated that estimates have been prepared of manufacturing cost, and, judging from inquiries received, it is anticipated that the demand will be such as to enable the earnings during the first year to reach a total sufficient to pay a dividend of not less than 10 per cent. on the capital, and, in addition, provide for depreciation and reserve. There is no information vouchsafed to guide the would-be investor as to whether this is a modest or an extravagant estimate. A dividend of 10 per cent. in the first year, however, strikes us as being a little optimistic, if we bear in mind that the factory is only being considered, and that only "inquiries" have been received. The only information given bearing on the probable future earnings, is a statement of the number of rifle clubs, ranges, &c., in England with which business may be done, but the company retains for six months the right to purchase all the foreign patents, and can extend the option over another six months by paying £250.

Callender's Share and Investment Trust, Ltd.—This company has been offering for subscription an issue of £115,000 5 per cent. first mortgage debenture stock, the issue being guaranteed as to principal, interest, premium and sinking fund by Callender's Cable Co. The company will deal with the shares, debentures and debenture stock of other companies (mentioned in the prospectus) which the company acquired, on its formation, from Callender's Co. The matter was referred to at the recent annual meeting of the latter company.

British Columbia Telephone Co., Ltd.—Messrs, Brown, Shipley and Co., recently offered £400,000 4½ per cent. first mortgage debenture stock in this company at £94 10s. per cent., and 5,000 6 per cent. cumulative preference shares of $100 each, at 98½ per cent.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee to appoint a special settling day in and grant a quotation to :—

Alby United Carbide Factories, Ltd.—Further issue of 150,000 5½ per cent. cumulative preference shares (convertible until June 30th, 1915) of £1 each, 10s. paid, (Nos. 400,001 to 550,000).

And to appoint a special settling day in :—

Compania de Electricidad de la Provincia de Buenos Aires, Ltd.—250,000 shares of £4 each, fully paid (Nos. 1 to 250,000) (share warrants to bearer).

Applications have been made to the Committee to allow the following securities to be quoted in the Official List :—

Consolidated Gas, Electric Light and Power Co., of Baltimore.—$700,000 additional common stock, in shares of $100 each.

United Electric Tramways of Monte Video, Ltd.—£100,000 additional 5 per cent. first debenture stock.

The S. and H. Co. in Russia.—The report for 1911 of the Russian Electrotechnical Works of Siemens & Halske, St. Petersburg, states that increasing business had rendered it necessary to extend the workshops, which had now been completed. The new shops were mainly devoted to the construction of dynamos, motors and transformers, whilst the production of apparatus for heavy currents for all branches of light currents was continued in the old works. During 1911 the trade development made further progress and favourably influenced the working results, which showed an increase. Including the balance forward the accounts show a surplus of £52,000, as compared with £42,000 in 1910. After allocating £10,000 to depreciation, and placing £2,500 to the reserve fund, it is proposed to pay a dividend of 6 per cent. on the share capital of £560,000, this contrasting with 5 per cent. in 1910. A fresh increase in orders is reported to have taken place in the new financial year.

Spanish and General Wireless Trust, Ltd.—The statutory meeting of this company was held on May 9th at the Hotel Metropole, London, Mr. G. C. Isaacs, presiding. The chairman said that, of the 249,007 shares allotted, 247.000 had been allotted in payment of 12,350 bearer shares of 500 pesetas each in La Compania Nacional de Telegrafia sin Hilos. That was the extent of the company's business transactions to that date. The company mentioned was formed in December 1910 in Spain, under Spanish laws, to secure the Marconi rights for Spain and Spanish Colonies, and to erect a number of high-power and ship stations under a concession from the Spanish Government. A contract was entered into between the Spanish company and the Marconi Wireless Telegraph Co. for the erection of these stations. The first were erected in Teneriffe and Las Palmas, in the Canary Islands, Cadiz, Vigo, Barcelona and Soller, on the Island of Majorca. The last was completed at Aranjuez (Madrid). All these stations were now at work communicating between the shore and ships at sea, and were ready for the conduct of an international telegraph service. A considerable business was being done between Spain and the Canary Islands. When the war in Tripoli ended, arrangements would be made to open up the service between Spain and Italy, and it was contemplated that, before long, a service would be conducted between England, Spain, and the Canary Islands. This would involve a service from the Canary Islands and Spain to the U.S.A. and Canada through England.

Official Announcements re Companies.—The following companies will, unless cause is shown to the contrary, be struck off the register within three months, and will accordingly be dissolved :—

Cape Town-Cairo Railway and Telegraph Combination Syndicate, Ltd.
Chorley and District Tramways, Ltd.
De Martis Electric Storage Syndicate, Ltd.
Electrical Trolley Head Co., Ltd.
Electrical Entertainment Syndicate, Ltd.
Electrical Ordnance Co., Ltd.
Electro-Metallurgical Syndicate, Ltd.
Electro Scrip Sign Co., Ltd.
Gravity Flame Arc Lamps, Ltd.
Hart-Dartnall Syndicate, Ltd.
Holmquist Electrical Co., Ltd.
Ljungstrom Engine, Boiler, and Condenser Co., Ltd.
Mersea Motor and Electric Co., Ltd.
Mountain & Gibson & Thornewill, Ltd.
National Radium Trust, Ltd.
Palmer & Co. (Electricians), Ltd.
Perth Traction and Development Co., Ltd.
Pollak-Virag Telegraph Co., Ltd.
Premier Electric Institute, Ltd.
Steel Wings Wind Turbine Co., Ltd.
Technical Press Bureau, Ltd.
Wireless Syndicate, Ltd.

Austrian Manufacturing Works.—The directors of Felten & Guilleaume, A.G., of Vienna, report that remunerative employment was provided for the company's works in 1911, by the extension of the telephone network in Vienna, whilst the ironworks in Styria derived advantage from the increasing demand in the iron and steel industry. The net profits are returned at £102,000, or £17,000 more than in 1910. The provision made for depreciation absorbs £17,000, and the balance permits of the payment of a dividend of 16¼ per cent., as against 15 per cent. in 1910. A favourable opinion is entertained of the prospects for the current year, as the development of the Vienna telephone system is being continued, and the company has secured large orders. Large extensions of the telephone networks are also proceeding in provincial towns, and progress is being made in connection with light and power supply works and in the erection of new works.

The report of the A.E.G. Union Elektrizitäts Gesellschaft, of Vienna, states that the general industrial revival in 1911 exercised a favourable influence on the company's business. The volume of orders was the highest during the existence of the company, and the orders brought over into 1912 were substantially larger than was the case a year ago. As gross profits the accounts indicate the sum of £110,000, as contrasted with £93,000 in 1910. After meeting general expenses and apportioning £14,000 to depreciation, the net profits amount to £44,000, as against £33,000 in the previous year. It is intended to pay a dividend of 7 per cent., being the same rate, although on less capital, as in 1910.

Shanghai Electric Construction Co., Ltd.—The directors' report states that the accounts for the year to December 31st show a profit of £14,139, as compared with £7,583 for 1910. The total standing to credit of profit and loss account at the end of the year, including the balance brought forward, was £20,773, which has been disposed of as follows :—Amount written off general expenditure during construction, £7,472 ; transfer to reserve for renewals, £10 000 ; carried forward, £3,301. Substantial progress has again been made in the number of passengers carried, the traffic receipts per car-mile, the gross earnings and the net operating receipts. This improvement has been obtained by continuing the policy of popularising the cars by means of more attractive short-distance fares. The percentage of loss by exchange on subsidiary coinage was, on the average, somewhat lower in 1911 than in 1910, but has recently shown a tendency to increase. The loss under this head for the year was £15,477, equivalent to over 4¼ per cent. on the capital of the company. The 30 trailers referred to in the last report were in use for a considerable portion of the year, with satisfactory results. The capital expenditure for the year, amounting to £11,526, which was mainly in respect of the additional rolling stock and the wayside car-shed required for its accommodation, has been met out of revenue. The further augmentation of the rolling stock by the addition of motor-cars, as well as trailers, is now called for in order to accommodate the growing traffic, and the system of feeder cables is being strengthened for the same reason.—*Financier.*

Hindhead and District Electric Light Co., Ltd.—Mr. John Grover presided at the annual meeting held last week. The report referred to the fire at the generating station, and stated that the new buildings had been made practically fire-proof. The net profit amounted to £1,781. The directors recommended a final dividend of 3 per cent., making a total of 5½ per cent. for the year, absorbing £533, and leaving £288 to be carried forward.

MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and may vary according to quantities and other circumstances.

Wednesday, May 22nd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a " Nitric	"	22/-	..
a " Oxalic	per lb.	2¾d.	..
a " Sulphuric	per cwt.	5/6	..
a Ammoniac Sal	"	42/-	..
a Ammonia, Muriate (large crystal)	per ton	£29 10	..
a Bleaching powder	"	£5 10	..
a Bisulphide of Carbon	"	£16	..
a Borax	"	£16 10	..
a Copper Sulphate	"	£24 15	..
a Lead, Nitrate	"	£26 10	..
a " White Sugar	"	£25 10	..
a " Peroxide	"	£82	..
c Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (88/90 %) ..	per ton	£22 10	..
a " Chlorate	per lb.	3½d.	..
a " Perchlorate	"	4½d.	..
a Potassium, Cyanide (98/100 %) .. (for mining purposes only)	"	7½d.	..
a Shellac	per cwt.	75/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	"	£6 10	..
a " Recovered	"	£5 10	..
a " Lump	"	£5 5	..
a Soda, Caustic (white 70/72 %) ..	"	£10 5	..
a " Chlorate	per lb.	3½d.	..
a " Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	3d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£70	£3 inc.
b " Wire, in ton lots ..	"	£102	..
b " Sheet, in ton lots ..	"	£120	..
p Babbitt's metal ingots	"	£88 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	8⅔d.	½d. inc.
c " Tube (brazed)	"	11½d.	½d. inc.
c " " (solid drawn) ..	"	9⅝d.	½d. inc.
c " Wire, basis	"	8⅔d.	½d. dec.
c Copper Tubes (brazed)	"	11⅞d.	½d. inc.
c " " (solid drawn)	"	11½d.	½d. inc.
g " Bars (best selected) ..	per ton	£90	£4 inc.
g " Sheet	"	£90	£4 inc.
g " Rod	"	£90	£4 inc.
d " (Electrolytic) Bars	"	£76 10	£2 inc.
d " " Sheets ..	"	£98 10	£2 inc.
d " " Rods	"	£81 10	£2 inc.
d " " H.C. Wire	per lb.	9⅔d.	½d. inc.
f Ebonite Rod	"	5/8	..
f " Sheet	"	4/9	..
n German Silver Wire	"	1/11	..
b Gutta-percha, fine	"		..
h India-rubber, Para fine	"	4/7½	½d. dec.
j Iron Pig (Cleveland warrants) ..	per ton	53/11½	10d. inc.
l " Wire, galv. No. 8, P.O. qual.	"	£14	..
g Lead, English Pig	"	£13 1fs.	..
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£8 5	..
e Mica (in original cases) small ..	per lb.	6d. to 8s.	1/- inc.
e " " " medium	"	3/6 to 6/-	1/- to 2/- inc.
e " " " large ..	"	7/6 to 11/-	3/- inc.
p Phosphor Bronze, plain castings	"	11d.	..
p " " rolled bars & rods	"	1/0½	..
p " " rolled strip & sheet	"	1/1	..
o Platinum	per oz.	185/-	..
d Silicium Bronze Wire	per lb.	10½d.	..
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	"	£209 to £211	£3 dec.
n " Wire, Nos. 1 to 16	per lb.	2/5	½d. inc.
p White Anti-friction Metals ..	per ton	£45 to £150	..
k Zinc, Sh't (Vieille Montagne bnd.)	"	£29 15	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
j Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

STOCKS AND SHARES.

Tuesday Evening.

STOCK Exchange markets began the week in a frame of mind the reverse of cheerful, and although a general fall tempted purchases, the net result has been to reduce values substantially in a good many directions. Searching for reasons to explain a decline due mainly to financial indigestion, the Stock Exchange authorities threw out dark hints as to possible political complications abroad, while they professed to scent danger in the various naval manœuvres in home and foreign waters, none of which reasons, however, deceived those who are acquainted with the true state of the stale bull account in many markets, added to which is the fresh outbreak of strike fever on the Thames and elsewhere.

The steady and substantial fall in Consols adds extra bitterness to the Home Railway market, already oppressed and weak. Gambling in Home Rails too often ends in discomfiture for the buyers, and many prices fell sharply. Central Londons have given way, the Deferred and Ordinary being down 2 and 1 respectively. Great Northern and City Preferred Ordinary are rapidly sliding back, and show a fall of 5s. City and South London dropped 1¼. East Londons fell to 7⅞, after being 10, and then recovered to 8. The Fourth stock is down to 17½. Districts, after keeping comparatively steady, went back 2 points, and Metropolitans show a loss of 1¾. Underground Electric Railways shares eased off to 4¼, the income bonds going back a point. A new stock of this undertaking has recently been introduced in the shape of a 6 per cent. First Cumulative Income Debenture, the price of which is 117 middle. The "A" shares, of 1s. each, rose to 17s. 3d., and reverted to 16s., the firmness of these being due to optimistic estimates of what the company is likely to earn in respect of the current year. Brighton Railway stocks have been very flat, the Deferred falling to 100½, as compared with 105½ quite lately. It is perfectly evident that buyers over-calculated their resources; or, to use an American vulgarism, that they have "bitten off more than they can chew," but the severe liquidation has brought in a few buyers, and prices look as though they had gravelled for the time being.

Electric Tramway issues are not much changed. British Electric Traction 6 per cent. Preference is down a point, but the company's two debenture stocks are higher. Isle of Thanet Preference eased off to 2½. London United Trams Preference went off ⅛. There is not much going on in Metropolitan Electric Tramways descriptions.

The list of English Electricity Supply stocks and shares is monotonously firm. There are few changes worth mentioning. Advances of ½ took place in St. James' Preference, Metropolitan Preference, and London Electric Ordinary. The market in City of London shares has quieted down to some extent, and there has been a certain amount of selling, which caused falls of 10s. in the Ordinary and Preference. Counties fell ½. The improvements in Bournemouth and Poole failed to bring any shares to market.

The Telegraph department has been affected somewhat as the result of sales by speculators, and the gamble in Marconis brought about several Stock Exchange failures. Clients who had been plunging heavily in the shares omitted to pay their differences, and innocent people had to suffer. On the week, Marconi Ordinary are $\frac{7}{16}$ down, and the Preference 12s. 6d. There is a huge account open in American Marconi shares, the price of which fell at one time to 2, or just half that to which the shares were run up some few weeks back. They have recovered to 2½, but the special settlement in the shares—the date of which has not yet been fixed—is awaited with considerable nervousness in the Stock Exchange. Canadian Marconis and Spanish and General Trusts weakened in sympathy. Moralising would, of course, be out of place in this column, but it is difficult to refrain from the observation that the Marconi affair adds one more to the long and melancholy list of speculative manias indulged in by people with more optimism than money.

West India and Panama Telegraphs have again been scaled down on fresh selling by weak holders. At 2$\frac{15}{16}$ the price shows a fall of 8s. 9d., following upon a drop of 7s. 6d. last week. Anglo-American Deferred is also ⅜ down, but the Eastern group continues very steady. Reuters lost the 5s. which they picked up a week ago, and the price has receded to 11¼. Callenders are marked *ex* the dividend of 10s., and this amount has been taken off the price of the shares. The issue of the new Callender's Share and Investment Trust Debenture stock has not affected the market in Callender's shares. A nominal premium of 1 per cent. is quoted on the stock, which appears to be a good investment, although the price of par is perhaps a little high. Underwriters received 3 per cent. in cash and £5,600 stock, which seems to be quite sufficient, considering the nature of the security. British Insulated and Helsby's Preference are 5s. better at 6¼ middle. National Telephone Deferred fell back 6 points, but the Preferred have hardened up to 101½, the stock changing hands pretty freely on this basis.

The news from Mexico is judged satisfactory, and one feature of the week in the market with which we deal has been a rise of 5½ points in Mexican Light and Power Common shares. The buying of these has been coming from abroad as well as at home, and rumours are in the air of an increase in the 4 per cent. dividend at present distributed quarterly. Possibly the substantial rise which has taken place recently in Rio Trams may have some indirect connection with the jump in Mexican Light and Power, and it is a little curious to note that the Company's Preferred shares are a point down. Mexico Trams are ½ lower, but the 6 per cent. bonds hardened to 104½. The rest of the Canadian-Latin issues are very steady. Sao Paulo Trams are marked up 13. Shawinigan Water at 144 is 5 points better. West Kootenay bonds continue to improve. Montreal Light and Power shares are 2 up. On the other hand, Canadian General Electrics receded a little after their sharp rise. River Plate Ordinary is quoted 5 down, but this is twice covered by the dividend of £10 deducted last week. Rio Trams have been keeping steady, and the Second bonds are better. Of the other issues, Anglo-Argentines are firmer, British Columbia Electric Deferred rose 1, and Victoria Falls Preference are $\frac{1}{16}$ down. Business in this section, however, has dwindled considerably, and the dealers admit that they now have time to get away for 10 minutes to lunch, which they aver is quite a change for them.

Manufacturing shares are quiet and somewhat neglected. The noticeable feature was a rise of $\frac{3}{16}$ in Babcock & Wilcox, but of this ⅛ was lost later. There was a little rise in Rubber shares, in consequence of several excellent reports which came out a day or two ago. The market for the commodity is steady, and so long as it keeps about the present figure of 4s. 8d. per lb., the producing companies can, of course, earn splendid profits.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for		Closing Quotations May 21st.	Rise + or Fall —	Present Yield p.c.
	*	1910.	1911.			£ s. d.
Bournemouth & Poole, Ord. ..	10	5½	5½	9¼ — 10¼	..	5 4 9
Do. 4½ % Pref.	10	4½	4½	8¾ — 9¼	..	4 12 2
Do. Second 6 % Pref. ..	10	6	6	10¾ — 11	..	5 9 1
Do. 4½ % Deb. Stock	Stock	4½	4½	100 —102	..	4 8 8
Brompton & Kensington, Ord...	5	10	10†	8½ — 8¾	..	5 14 8
Do. 7 % Cum. Pref.	5	7	7	7⅞ — 8¼	..	4 6 2
Central Electric Supply, 4 % Guar. Deb.	100	4	4	98 —101	..	3 19 8
Charing Cross, West End & City	5	5	5	4⅞ — 5	..	5 0 0
Do. 4½ % Cum. Pref... ..	5	4½	4½	4⅜ — 4½	..	4 14 9
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	8¾ — 4⅜	..	5 2 10
Do. Do. 4 % Deb... ..	100	4	4	95 — 98	..	4 1 8
Chelsea, Ord.	5	5	5	4⅜ — 4⅞	..	5 2 7
Do. 4½ % Deb.	Stock	4½	4½	98 —101	..	4 9 1
City of London, Ord.	10	7	8	20½ — 22½	— ½	3 11 1
Do. 6 % Cum. Pref.	10	6	6	17 — 19	— ½	3 3 2
Do. 5 % Deb.	Stock	5	5	119 —123	..	4 1 4
Do. 4½ % Second Deb. ..	100	4½	4½	101 —104	..	4 6 7
County of London, Ord... ..	10	5	6	10⅜ — 11½	— ⅛	5 7 10
Do. 6 % Pref.	10	6	6	11½ — 11¾	..	5 2 7
Do. 4½ % Deb.	Stock	4½	4½	108 —110	..	4 1 10
Do. 4½ % Second Deb. ..	Stock	4½	4½	99 —102 xd	..	4 8 8
Edmundson's, Ord.	5	Nil	Nil	⅛ — ¼	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	3— 3½	..	Nil
Do. 4½ % First Mort. Deb. ..	100	4½	4½	86 — 89	..	5 1 2
Folkestone	5	6	6	4⅜ — 4⅞	..	6 3 1
Do. 5 % Cum. Pref.	5	5	5	4⅜ — 4⅝	..	5 5 8
Do. 4½ % First Deb.	100	4½	4½	93 — 96	..	4 13 9
Hove	5	9	9	6⅛ — 7	..	6 8 7

NAME.	Stock or Share.	Dividends for		Closing Quotations May 21st.	Rise + or Fall —	Present Yield p.c.
	*	1910.	1911.			£ s. d.
Kensington & Knightsbridge, Ord	5	9	9	7⅛ — 7⅞	..	5 16 2
Do. 4 % Deb.	Stock	4	4	92 — 95	..	4 4 3
Kent Elec. Power, 4½ % Deb. ..	Stock	4½	4½	80 — 84	..	5 7 2
London Electric, Ord.	3	2	2½	1⅜ — 2⅛	+ ⅛	3 10 5
Do. 6 % Pref.	5	6	6	4½ — 5½	..	5 14 3
Do. 4 % First Mort. Deb. ..	Stock	4	4	92 — 95	..	4 4 3
Metropolitan	5	5	4†	8⅜ — 4⅛	..	6 1 3
Do. 4½ % Cum. Pref... ..	5	4½	4½	4⅜ — 4⅝	+ ⅛	4 14 9
Do. 4½ % First Mort. Deb...	Stock	4½	4½	101 —104	..	4 6 7
Do. 3½ % Mort. Deb... ..	Stock	3½	3½	85 — 88	..	3 19 7
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	96 — 98	..	4 11 10
Newcastle-on-Tyne 5 % Pref., Non-Cum.	5	5	5	3⅞ — 4⅛	..	5 14 3
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	97 —100 xd	..	5 0 0
Notting Hill, 6 % Non-Cum. Pref.	10	..	6	10½ — 11½	..	5 6 8
Oxford	5	7½	7½	5⅞ — 6⅜	..	5 13 9
St. James' and Pall Mall, Ord.	5	10	10	8 — 8⅜	..	5 14 3
Do. 7 % Pref.	5	7	7	6⅛ — 7⅜	+ ⅛	4 15 0
Do. 3½ % Deb.	100	3½	3½	85 — 87	..	4 0 6
Smithfield Markets, Ord. ..	5	Nil	2	1⅜ — 1⅝	..	..
South London, Ord.	4	5	5	3⅜ — 3⅝	..	6 8 0
Do. 5 % First Mort. Deb. ..	100	5	5	99 —102	..	4 18 0
South Metropolitan, 7 % Pref...	1	7	7	1⅜ — 1⅝	..	6 1 0
Do. 4½ % First Deb. Stock ..	100	4½	4½	96 — 99	..	4 11 0
Urban, Ord...	5	5	..	¼ — ½	..	..
Do. 5 % Cum. Pref.	5	5	..	2⅜ — 3⅛	..	..
Do. 4½ % First Mort. Deb. ..	100	4½	4½	86 — 88	..	5 2 3
Westminster, Ord.	5	10	10	8½ — 9	..	5 11 1
Do. 4½ % Cum. Pref... ..	5	4½	4½	5⅛ — 5⅜	..	4 4 8

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅜ — 5⅞	..	5 2 2
Calcutta, Ord.	5	8½	8½	7⅛ — 7⅜ xd	— ⅛	5 9 8
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 15 3
Calgary Power, 1st Mort. Bds.	100	5	5	94½ — 96½	..	5 3 8
Canadian Gen. El. Com. ..	$100	7	7†	112 —116	—2	6 0 8
Do. 7 % Pref.	$100	7	7	118 —122	..	5 14 9
Cordoba Lt., Power and T., Ord.	1	3	3†	1⅛ — 1⅝	..	3 4 0
Do. 5 % Deb.	100	5	..	94 — 97	..	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	95½ — 97½	+2½	6 3 1
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	83 — 86	..	5 16 3
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	92 — 94	..	5 6 5
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	7/16 — 9/16	..	Nil
Do. 6 % Pref.	1	6	6	3⅞ — 3¾	..	8 6 0
Kaministiquia Power, 5 % G. Bs.	$500	5	5	103 —106	..	4 15 3
Madras, Ord.	5	..	..	2¼ — 2⅜	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	102½—105½	..	4 14 9
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	87½ — 89½	..	5 11 9
Mexican Lt. & Power, Common	$100	4	4	91 — 93	+5½	4 6 0
Do. 7 % Cum. Pref.	$100	7	7	104 —106	—1	5 12 1
Do. 5 % 1st Mort. Gold Bds.	..	5	5	96 — 98	..	5 2 0

Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	87½ — 89½	..	5 11 9
Montreal, Lt., H. and Power ..	$100	7	8	209 —213	+1	3 15 1
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	..	39 — 41	..	12 8 10
River Plate, Ord.	Stock	10	10	240 —250 xd	—5	4 0 0
Do. 6 % Non-Cum. Pref. ..	Do.	6	6	109 —114 xd	..	5 5 3
Do. 5 % Deb. Stock	Do.	5	5	103 —105	..	4 15 3
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	99 —101	..	4 9 1
Shawinigan Water, Capital ..	$100	4	5†	142 —146	+5	3 8 6
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	108½—110½	..	4 10 6
Do. 4½ % Per. Deb.	Stock	4½	4½	102½—104½ xd	..	4 6 2
Toronto Power, 4½ % Deb. ..	Do.	4½	4½	100½—102½	..	4 7 10
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	92½— 94½	..	5 5 10
Victoria Falls Power, Pref. ..	1	Nil	11¾d.	7/16 — 11/16	— 1/32	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	105½—107½	+ ½	5 11 7

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	4†	7⅛ — 7⅜	..	..
Do. 5 % Deb. Red.	Stock	5	5	97½ — 99½	..	5 0 6
American Telep. & Teleg., Cap.	$100	8	8†	148½—150½	..	5 6 4
Do. Collat. Trust	$1000	4	4	95 — 97	..	4 2 6
Anglo-American Telegraph ..	Stock	3¾	3	65 — 67	..	4 9 7
Do. 6 % Pref.	Do.	6	6	107⅞—108⅞	+ ⅛	5 10 4
Do. Def.	Do.	80/-	80/-	25⅜ — 25⅝	— ⅜	5 16 0
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	102 —104	..	4 16 2
Chili Telephone	5	7	..	7⅞ — 8	..	4 10 4
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	82½ — 84½	..	4 14 8
Cuba Telegraph	10	6	6†	9½ — 10⅝ xd	..	5 14 3
Do. 10 % Pref.	10	10	10	16½ — 17⅞ xd	..	5 14 3
Direct Spanish Telegraph, Ord.	5	4	4†	3½ — 3⅝	..	5 6 8
Do. 10 % Cum. Pref.	5	10	10	7⅜ — 8	— ¼	6 5 0
Direct United States Cable ..	10	4½	5	7⅛ — 8	..	6 5 0
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	99½—101½	+ ½	4 8 8
Eastern Telegraph, Ord. Stock	Stock	7	5†	135½—138½	..	5 1 1
Do. 8½ % Pref. Stock.. ..	Do.	8½	8½	80½ — 82½	..	4 4 10
Do. 4 % Mort. Deb.	Do.	4	4	99½—101½	..	3 18 10
Eastern Extension	10	7	5†	12¾ — 13⅛ xd	..	5 5 8
Do. 4 % Deb.	Stock	4	4	99 —101	..	3 19 3
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	97 —100	..	4 0 0
Globe Telegraph and Trust ..	10	5⅞	6†	10⅞ — 11⅜	..	5 5 6
Do. 6 % Pref.	10	6	6	13 — 13½	..	4 9 0
Great Northern Telegraph ..	10	18	18	30 — 31	— ¼	5 12 6
Indo-European Telegraph ..	25	13	5†	56 — 58	—2	5 12 1
Mackay Companies Common ..	$100	5	5†	87 — 90	..	5 11 1
Do. 4 % Cum. Pref.	$100	4	4	69 — 72	..	5 11 1
Marconi's Wireless Telegraph	1	5	..	6⅛ — 6⅜	— 1/16	..
Do. 7 % Cum. Partic. Pref.	1	16	..	5⅛ — 5⅜	— ⅛	..

Monte Video Telephone, Ord. ..	1	6	6	1 — 1⅛	..	5 6 3
Do. 5 % Pref.	1	5	5	3/16 — 3/8	..	5 10 6
National Telephone, Pref. ..	Stock	6	6†	99½—102½	..	..
Do. Def.	Do.	6	6†	123 —155	—6	..
Do. 5 % Non-cum. 3rd Pref.	5	5	5	6¼ — 6⅜	..	..
New York Telep., 4½% Gen. Bnds.	100	4½	4½	100 —101	..	4 7 2
Oriental Telep. and Elec. ..	1	8	8	1⅛ — 1⅜	..	4 18 0
Do. 6 % Cum. Pref.	1	6	6	1⅛ — 1⅜	..	4 16 0
Do. 4 % Red. Deb.	Stock	4	4	89 — 91	..	4 8 0
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	99½—101½	..	3 18 10
Reuter's	8	5	5†	11 — 11½	— ½	3 9 7
Submarine Cables Trust ..	Cert.	6	6	127 —130	..	4 12 4
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	99 —101	..	4 9 1
United River Plate Telephone	5	8	8	7⅜ — 7⅞	..	5 1 ..
Do. 5 % Cum. Pref.	5	5	5	5⅛ — 5⅜	..	4 8 11
West Coast of America	2½	2½	2½	1⅛ — 1⅜ xd	— 1/16	3 11 5
Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4	4	94½— 97½	..	4 2 1
West India and Panama Teleg.	10	1½	1½	2⅛ — 3⅛	— 7/16	3 11 5
Do. 6 % Cum. 1st Pref. ..	10	6	6	10⅛ — 11	..	5 9 1
Do. 6 % Cum. 2nd Pref. ..	10	6	6	9⅛ — 10⅛	..	5 17 1
Do. 5 % Debs.	100	5	5	102½—104½	..	4 15 8
Western Telegraph, Ltd. ..	10	7	6†	18½ — 19⅜	..	5 2 9
Do. 4 % Deb.	Stock	4	4	98 —100	..	4 0 0
Western Union 4½ % Fdg. Bonds	$1000	4½	4½	100 —103	..	4 7 5

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Continued on next page

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations May 21st.	Rise + or Fall —	Present Yield p.c. £ s. d.
	*					
Bath Trams, Pref. Ord.	1	Nil	Nil	7/32 — 11/32	..	Nil
Do. 5 % Pref.	1	5	5	7/8 — 15/16	..	6 8 1
Do. 4½ % Deb.	100	4½	4½	78 — 83	..	5 8 5
Brit. Elec. Trac., 6 % Pref.	100	..	..	11 — 13	−1	..
Do. Do. Deferred	100	..	..	6¼ — 8½	..	..
Do. Do. 6 % Cum. Pr'f.	100	..	6	92 — 94	..	6 7 8
Do. 7 % Non-Cum. Pr'f.	100	..	..	44 — 48	..	..
Do. 5 % Perp. Deb.	100	5	5	94 — 97	+ ½	5 3 1
Do. 4½ % 2nd Deb.	100	4½	4½	79 — 83	+1	5 8 5
Central London Railway, Ord.	100	3	3	81 — 83	−1	3 12 3
Do. Pref.	100	4	4	86 — 88	..	4 11 0
Do. Def.	100	2	2	81 — 83	−2	2 8 2
Do. 4 % Deb.	100	4	4	101 —103	..	3 17 8
City & South London, Ord.	100	1½	1½	37 — 38	−1½	4 5 6
Do. 5 % Pref., 1891	100	5	5	108 —110	..	4 11 0
Do. Do. 1896	100	5	5	104 —106	..	4 15 3
Do. Do. 1901	100	5	5	104 —106	..	4 14 4
Do. Do. 1908	100	5	5	103 —105	..	4 15 3
Do. 4 % Deb.	100	4	4	99 —101	..	3 19 3
Dublin United Trams, 6 % Pref.	10	6	6	10½ — 11½	..	5 2 2
Great Northern & City, Pr'f. Ord	10	Nil	..	1/2 — 1/2	− 1/2	Nil
Hastings Trams, 6 % Pref.	5	Nil	6	0 — 3/4	..	8 0 0
Do. 4½ % Deb.	100	4½	4½	71 — 76	..	5 18 5
Isle of Thanet Trams, 5 % Pref.	5	2½	2½	2¼ — 2½	− 1/8	4 11 0
Do. 4 % Deb.	100	4	4	75 — 80	..	5 0 0
Lancashire United, 5 % Deb.	100	5	5	83 — 85	..	5 17 8
London Elec. Railw'ys, 4 % Deb.	100	4	4	97 — 99	..	4 0 10
London United Trams, 5 % Pref.	10	Nil	..	5 1/2 — 5 3/4	− 1/8	..
Do. 4 % Deb.	100	4	4	78 — 81	..	4 18 9
Metropolitan Railway Consol.	100	1⅞	1⅞	68 — 68½	−1¼	2 14 9
Do. Surplus Lands	100	2⅜	2⅜	67 — 69	..	4 3 4
Do. 3½ % Deb.	100	3½	3½	89 — 91	..	3 16 11
Do. 3½ % Pref.	100	3½	3½	86 — 88	..	3 19 7
Do. 3½ % Con. Pref.	100	3½	3½	87 — 89	..	3 18 8
Metropolitan District Ord.	100	Nil	..	43 — 43½	−2	Nil
Do. 6 % Deb.	100	6	6	144 —146	..	4 2 2
Do. 4 % Deb.	100	4	4	96 — 98	..	4 1 8
Do. 4 % Prior Lien	100	4	4	98 —100 xd	..	4 0 0
Do. 4½ % First Pref.	100	3¾	4½	90 — 92	..	4 17 10
Do. 3½ % Gtd.	100	3½	3½	76 — 78	..	4 9 9
Metropolitan Elec. Trams, Ord.	1	5/8	6	1 1/8 — 1	..	6 0 0
Do. Def.	1	Nil	..	1/8 — 3/8	..	Nil
Do. 5 % Pref.	1	5	5	3/8 — 5/8	..	5 10 6
Do. 4½ % Deb.	100	4½	4½	98 —100	..	4 10 0
Do. 5 % Deb.	100	5	5	98 —100	..	5 0 0
Potteries, Ord.	1	2	..	3/8 — 1/2	..	..
Do. 5 % Pref.	1	5	5	1 1/16 — 1 3/16	..	6 19 8
Do. 4½ % Deb.	100	4½	4½	87 — 90 xd	..	5 0 0
South Metro. Trams, 6 % Pref.	1	6	..	3/4 — 7/8	..	6 17 2
Do. 4 % Deb.	100	4	4	72 — 77	..	5 4 0
Underground Elec. Railways	10	..	..	4 1/2 — 4 3/8	— 1/8	Nil
Do. 4½ % Bonds	100	4½	4½	99 —101	..	4 9 1
Do. 6 % Income	100	1	1½†	90 — 92	−1	
Yorkshire (West Riding), Ord.	5	Nil	..	1/8 — 3/8	..	Nil
Do. 6 % Pref.	5	Nil	..	2 1/4 — 2 1/2	..	Nil
Do. 4½ % Deb.	100	4½	4½	80 — 84	..	5 7

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5½	5 1/2 — 5 3/4	+ 1/16	5 0 0
Do. 2nd Pref.	5	5	5½	4 13/16 — 5 1/16	+ 1/16	5 6 0
Do. 4 % Deb.	100	4	4	95 — 96½	+1	4 2 11
Do. 4½ % Deb.	100	4½	4½	102 —104	..	4 6 7
Do. 5 % Deb.	100	5	5	103 —105	..	4 15 3
Auckland Trams, 5 % Deb.	100	5	5	104 —106	..	4 14 4
Bombay Elec. S. & Trams, Pref.	10	6	6	11 — 11½	..	5 4 4
Do. 4½ % Deb.	100	4½	4½	98 —100	..	4 10 0
Do. 5 % 2nd Deb.	100	5	5	99 —101	..	4 19 0
Brisbane Trams Invt., Ord.	5	8	8	9 — 9½	— 1/4	4 4 3
Do. 5 % Pref.	5	5	5	4 7/8 — 5 1/8	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	100 —103	..	4 7 5
B. Columbia Elec. Rly., Def.	100	8	8†	140 —144	+1	5 11 1
Do. Pref. Ord.	100	6	6	126½—129½	+ 1/2	4 13 5
Do. 5 % Pref.	100	5	5	111 —114	..	4 7 9
Do. 4½ % 1st Mort. Deb.	40	4½	4½	98½—101½	..	4 8 8
Do. 4½ % Vancouver Deb.	100	4½	4½	103 —105	..	4 5 9
Do. 4½ % Con. Deb.	100	4½	4½	104 —106	..	4 5 0
Calcutta Trams, Ord.	5	6	7	6 1/2 — 6 5/8	..	5 5 8
Do. 5 % Pref.	5	5	5	4 13/16 — 5 1/16	..	4 16 5
Do. 4½ % Deb.	100	4½	4½	100 —103	..	4 7 5
Cape Electric Trams	1	Nil	2½†	1/8 — 3/8	..	..
City Buenos Aires Trams (1904)	5	5	5	5 3/16 — 5 5/16	— 1/16	4 10 6
Do. 4 % Deb.	100	5	5	101 — 103	..	4 17 3
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	94 — 98	..	5 2 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	101 —104	..	4 16 2
Kalgoorlie Elec. Trams	1	Nil	..	1/32 — 3/32	..	Nil
Do. 5 % A Deb.	100	5	5	91 — 94	..	5 6 5
Do. 6 % B Deb.	100	5	6†	56 — 60	..	10 0 0
La Plata Elec. Trms, Ord.	1	..	..	1/8 — 3/4	..	..
Do. Pref.	1	6	6	13/16 — 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	5½	6	1 — 1 1/32 xd	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1 1/32	..	4 16 0
Do. 5 % Deb.	100	5	5	95 — 99	..	5 1 0
Madras Elec. Tr. (1904), Deb.	100	5	5	99 —101	..	4 19 0
Manaos Trams & Lt., 1st Deb.	100	5	5	93 — 96	..	5 4 2
Manila Elec. R. and Ltg., Bonds	$1000	5	5	102 —104	..	4 16 2
Mexico Trams Com.	$100	7	7	121½—123½	— 1/2	5 13 4
Do. Gen. Con. 5 % Bonds	..	5	5	96 — 98	..	5 2 0
Do. 6 % Bonds	100	6	6	108½—105½	+ 1/2	5 13 9
Para Elec. Rlys. & Lt., Ord.	5	10	10	7 — 7 1/8	..	6 15 7
Do. 6 % Pref.	5	6	6	5 — 5 1/8	..	7 0 4
Do. 5 % 1st Deb.	100	5	5	100 —102 xd	..	4 18 0
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	1 1/16 — 1 1/16	..	1 18 4
Do. 5 % 1st. Deb.	100	5	5	101 —104	..	4 16 2
Rangoon El. Tr. & Sup., Pref.	5	6	6	5 3/8 — 5 5/8	..	5 6 8
Do. 4½ % 1st Deb.	100	4½	4½	99 —101	..	4 9 1
Rio de Janeiro Trams	$100	4⅝	5†	133 —134	−1	3 14 8
Do. 1st Mort. 5 % Bonds	..	5	5	104 —105	..	4 15 3
Do. 5 % Mort. Bonds	100	5	5	98 3/4 — 99 3/4	+1	5 0 3
Sao Paulo Tram, Lt. and P.	$100	10	10†	235 —240	+13	4 3 4
Do. 5 % 1st Deb.	$500	5	5	105 —107	+ 1/2	4 13 6
Singapore Trams, 5 % Deb.	100	5	5	79 — 82	..	5 19 1
Southern El. Tr. B.A., 5 % Deb.	100	5	5	93 — 95	..	5 5 3
Un. Elec. Trams Monte Video	5	6	7	5 1/4 — 6	..	6 1 11
Do. 6 % Pref.	5	6	6	5 — 5 1/4	..	6 14 3
Do. 5 % 1st Deb.	100	5	5	100 —103 xd	..	4 17 1
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	103 —105	+ 1/2	4 5 9

MANUFACTURING COMPANIES.

Aron, Ord.	1	Nil	6	1 1/4 — 1 3/8	..	7 7 8
Do. 6 % Pref.	1	9	6	7/8 — 15/16	..	7 2 2
Babcock & Wilcox	1	26	28	6 3/4 — 6 7/8	+ 1/16	4 4 7
Do. Pref.	1	6	6	1 3/4 — 1 7/8	..	3 16 10
B.I. & Helsby Cables	5	10	10	6 7/8 — 7 1/8	..	6 18 0
Do. Pref.	5	6	6	6 — 6 1/4	+ 1/4	4 12 4
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
British Thomson-Houston, Deb.	100	4½	4½	91 1/4 — 94 1/4	..	4 15 8
British Westinghouse, Pref.	3	Nil	..	1/4 — 3/4	..	Nil
Do. Deb.	100	4	4	63 — 66	..	6 1 3
Do. 6 % Prior Lien	100	6	6	99 —102	..	5 17 8
Browett, Lindley, Ord.	1	Nil	..	1/6—2/-	..	Nil
Do. Pref.	1	Nil	..	5/- —6/-	..	Nil
Brush, 7 % Pref.	2	Nil	..	0 — 1/4	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	77½ — 82½	..	6 1 3
Do. 4½ % Deb.	100	4½	4½	54 — 59	..	7 10 6
Do. 4½ % Second Deb.	100	4½	4½	37 — 42	..	10 14 4
Callender's Cable	5	15	10†	10 3/4 — 11 1/4 xd	..	6 10 5
Do. Pref.	5	5	5	5 — 5 1/4	..	4 15 3
Do. Deb.	100	4½	4½	99 3/4 —101 1/4	..	4 8 8
Castner-Kellner	1	17/6	20	3 1/4 — 3 1/2	..	5 6 8
Do. Deb.	100	4½	4½	105 —109	..	4 10 7
Crompton & Co.	3	Nil	Nil	1/8 — 3/8	..	Nil
Do. Deb.	100	5	5	58 — 63	..	7 7 1
Dick, Kerr	1	5	..	3 7/8 — 3 15/16	..	5 3 1
Do. Pref.	1	6	6	1 7/8 — 1 15/16	..	5 12 11
Do. Deb.	100	4½	4½	97 —100	..	4 10 0
Edison & Swan, A, £8 paid	5	Nil	..	1/4 — 3/8	..	Nil
Do. fully paid	5	Nil	..	1/2 — 2 3/4	..	Nil
Do. 4 % Deb.	100	4	4	68 — 72	..	5 11 1
Do. 5 % Second Deb.	100	5	5	75 — 78	..	6 8 2
Electric Construction	2	Nil	2½†	3/4 — 1	..	..
Do. Pref.	2	7	7	1 3/4 — 2	..	7 0 0
Greenwood & Batley, Pref.	10	7	7	7 1/2 — 8 1/2	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	9 — 9 1/2	..	5 5 3
Do. Deb.	100	4	4	85 — 90	..	4 8 11
Henley's, Ord.	5	15	10†	11 3/4 — 12 1/4	..	6 0 0
Do. Pref.	5	4½	4½	4 11/16 — 5 1/16	..	4 6 9
Do. Deb.	100	4½	4½	103 —105	..	4 5 9
India-Rubber, G. & T.	10	10*	..	8 3/4 — 9 1/4	..	..
Do. Pref.	10	5	5	9 1/4 — 10 1/4	..	4 17 7
Telegraph Construction	12	20	10†	34 — 36	..	6 13 4
Do. Deb.	100	4	4	99 3/4 —101 1/4	..	4 9 0
Willans & Robinson	1	Nil	..	1/8 — 1/4	..	Nil
Do. Pref.	5	Nil	..	3/4 — 1	..	Nil
Do. Deb.	100	4	4	59 — 61	..	6 11 2

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

AN ELECTRIC LOCOMOTIVE WITH THE AUVERT-FERRAND RECTIFIER.

Le Génie Civil of February 17th gives an interesting account of the application of the special rectifier, designed by MM. Auvert and Ferrand, of the P.L.M. Railway, to an electric locomotive built by the Société Alioth, of Basle. Since the Compagnie des Chemins de fer du Midi intend to make comparative tests this year of six different types of electric locomotives, the particular type described here will no doubt be included.

Single-phase current is taken from an overhead line at 12,000 volts pressure with a periodicity of 25, and the pressure is reduced by transformers on the locomotive to that necessary to supply the rectifiers. The principle of the latter is as follows :—

On a built-up ring A (fig. 1) there are two windings as shown. These windings, fed at the points B and C by a single-phase current, produce a closed magnetic field in the ring. The latter, with the collector K, to which the sections of the windings are connected, is rotated by a synchronous motor on the same shaft, operated from

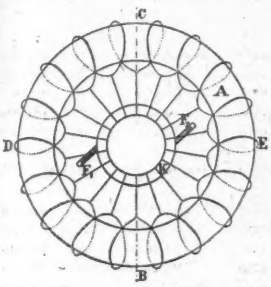


FIG. 1.

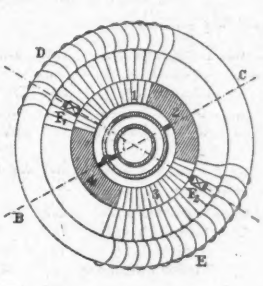


FIG. 2.

the single-phase secondary circuit, the points B and C being also connected to this circuit through collector rings. Two brushes, F_1 and F_2, are placed opposite one another. When the position of the brushes is such that they reach the points B and C at the moment of maximum pressure, the potential difference between the brushes will always be in the same direction, and will be represented by a curve of wave form. To improve the efficiency of the rectifier, the arrangement of the collector and the windings is different from the simple one shown in fig. 1. In practice that shown in fig. 2 is adopted :—

Here the collector K, instead of being divided up into equal insulated sections, is made with four groups of sections. The separate sections of the Groups 1 and 3 are insulated from one another, and connected to the windings of the ring. The sections of Groups 2 and 4, however, are connected in a body to the points C and B respectively. The brushes F_1 and F_2 are then in direct communication with the single-phase circuit all the time they are in contact with the Groups 2 and 4, and the windings are only effective while the brushes are passing over the Groups 1 and 3. If the four groups divide the collector into equal parts, then during half the time of each rotation the brushes are in direct communication with the circuit. If the brushes are so placed that they are at the middle of Groups 2 and 4 at the instant of maximum pressure, the difference of potential between the brushes will always be in the same direction. The machine may be built up of several similar sets of windings placed symetrically on the ring, with a separate collector to each set, and presents no particular difficulty of construction in this respect. By merely moving round the brush carrier representing one of the sets of windings, the pressure of the rectified current can be regulated without the necessity of changing the single-phase circuit.

The rectified current supplied by the machine is an undulating one if the circuit which it feeds is without self-induction, but by interposing a choking coil in this circuit the undulations are reduced to the practical limits of continuous-current working.

Fig. 3 gives the form of the curves of pressure and intensity for both the single-phase and rectified currents :—U_a represents the curve of single-phase voltage at the terminals of the rectifier; U_c represents the variation of voltage of the rectified current without self-induction in the rectified circuit; U'_c represents the variation of this pressure with a choking coil in the rectified circuit; i_a is the current curve for the single-phase current supplied to the rectifier; i_c is the current curve for the rectified current with a choking coil in this circuit.

It is not explained here, but appears from the drawing of the rectifier that the curves relate to a machine with two sets of windings. The positions of the two sets of brushes, corresponding to these curves, is such that there is an angular distance between the two sets of one quarter of the maximum distance used in working. The altering of this angle is equivalent to the changing of the number of coils in the secondary windings of a static transformer. Reducing the angle is equivalent to reducing the number of secondary coils.

The synchronous motors driving the rectifiers have only to overcome the friction of the moving parts. In order to avoid current surgings in these motors when variations of frequency and pressure occur in the line current, it is found necessary to have two rectifiers to each locomotive, with two separate driving motors. The two machines turn in opposite directions, and the two continuous current collectors are connected in series. Three equidistant points in one synchronous motor armature are connected to three corresponding points on the other armature, so as to ensure that the effect of any line variation will be the same on both motors. As

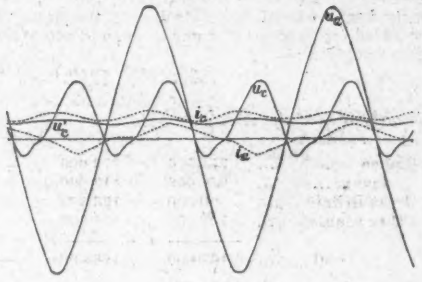


FIG. 3.

the latter turn in opposite directions, while the brushes of both rectifiers move in the same direction during a variation of pressure or frequency, the net result is to eliminate the effect of any current surging in the two motors.

An important part of the apparatus is the small controlling motor which adjusts the brush carriers of the rectifiers in accordance with the requirements of the load, and forms the whole means of control. This small motor has its armature traversed by a continuous current of low amperage supplied by a small motor-generator set on the locomotive.

The field magnets have two windings, one of fine wire carrying continuous current from the same source as the armature current, and of which both the amperage and the direction can be controlled by the driver; the other winding consists of four turns of the main wire carrying the rectified current for the main motors. By the interaction of these two windings the controlling motor turns in either direction or stops, and as it has a mechanical connection with the brush carriers of the rectifiers, the effect of altering the continuous current in its field windings is to control the rectified current taken from the main machines. The mechanical arrangement is such that when the brushes are in a position corresponding to minimum pressure in the rectified circuit, the high-tension current is automatically cut off from the main transformer. As soon as the controlling motor begins to move the brushes so as to augment the pressure in the rectified circuit, the high-tension circuit is again established by a special form of circuit-breaker.

The rectified current is supplied normally at 600 volts pressure to the two motors of each half of the locomotive, the latter consisting of two similar truck frames and bodies connected by a single central coupling. The two motors of each half are of 400 H.P. each, and are connected in series.

From results obtained it appears that the starting up of this locomotive is rapid and very regular. It ought certainly to have the latter qualification from its method of control. The power factor even at the commencement of movement of the train was maintained at above ·60. The efficiency of the whole locomotive, that is of the combined apparatus, was 78 to 80 per cent. It is interesting to note that in the tests which were made of this locomotive on the line from Cannes to Grasse (P.L.M. Railway) it was found possible to exert a high tractive effort on the draw-bar with the locomotive standing still for some minutes, without damaging the electrical apparatus in any way.

The chief points claimed for this system of rectified current electric drive are flexibility of control and working, and high efficiency. Comparisons are made with the disadvantages attending the use of single-phase driving motors, but as only synchronous motors are considered, the comparison is not a fair one. The commutator motors at present in use on single-phase systems are not subject to several of the inconveniences brought into the comparison. Besides this it would evidently not be practicable to apply any system of rectified or converted current drive to the multiple unit system of train propulsion, which has great advantages at any rate for suburban lines and short runs. The necessity for having two rectifiers to each locomotive also appears to be a disadvantage of the system.

However, the final test is efficiency in ordinary working and low cost of maintenance and repairs, and it will be interesting to have later the results of the trials of this form of locomotive compared with those of the other types shortly to be experimented with.

National Insurance.—The Board of Trade has issued from its Central Office for Labour Exchanges and Unemployment Insurance, Queen Anne's Chambers, Westminster, S.W., a "Provisional List of Workmen in the Insured Trades (Sixth Schedule)." It relates to the following sub-sections: Building; Construction of Works; Shipbuilding; Mechanical Engineering; Ironfounding; Construction of Vehicles; Sawmilling (including machine woodwork). Electrical wiremen, electrical winders, engine-men, stokers, boilermakers, crane-men, bladers (rotors and turbines), erectors, fitters, and commutator-makers are specifically mentioned in a number of these sections. Those interested in the matter should secure a copy of this document.

TRADE STATISTICS OF ITALY.

The following figures, showing the imports of electrical and similar goods into Italy during the year 1910, have been taken from the recently issued official trade statistics; the figures for 1909 have been added for purposes of comparison, and notes of increases or decreases are given :—

	1909. Lire.	1910. Lire.	Increase or decrease. Lire.
Copper, brass or bronze wire more than ½ mm. diameter.—			
From France	2,774,000	1,372,000	—1,402,000
„ Germany	1,267,000	1,517,000	+ 250,000
„ Great Britain ...	20,000	125,000	+ 105,000
„ Other countries ...	101,000	112,000	+ 11,000
Total ...	4,162,000	3,126,000	—1,036,000
Copper, brass or bronze wire of ½ mm. diameter or less.—			
From Germany	430,000	338,000	— 92,000
„ France	19,000	34,000	+ 15,000
„ Other countries ...	13,000	4,000	— 9,000
Total ...	462,000	376,000	— 86,000
Boilers.—			
From France	143,000	155,000	+ 12,000
„ Germany	552,000	717,000	+ 165,000
„ Great Britain ...	2,469,000	1,715,000	— 754,000
„ Switzerland ...	275,000	139,000	— 136,000
„ Other countries ...	428,000	306,000	— 122,000
Total ...	3,867,000	3,032,000	— 835,000
Steam engines, fixed without boilers.—			
From Belgium	160,000	7,000	— 153,000
„ Germany	540,000	306,000	— 234,000
„ Great Britain ...	739,000	1,100,000	+ 361,000
„ Switzerland ...	279,000	262,000	— 17,000
„ United States ...	132,000	169,000	+ 37,000
„ Other countries ...	230,000	137,000	— 93,000
Total ...	2,080,000	1,981,000	— 99,000
Steam engines, semi-fixed (with boilers), hot-air motors, compressed air, gas, petrol, &c.—			
From France	196,000	110,000	— 86,000
„ Germany	1,888,000	1,505,000	— 383,000
„ Great Britain ...	1,554,000	1,590,000	+ 36,000
„ Switzerland ...	366,000	599,000	+ 233,000
„ United States ...	323,000	231,000	— 92,000
„ Other countries ...	152,000	376,000	+ 224,000
Total ...	4,479,000	4,411,000	— 68,000
Hydraulic machines and water or wind motors.—			
From France	299,000	102,000	— 197,000
„ Germany	633,000	1,035,000	+ 402,000
„ Great Britain ...	116,000	962,000	+ 846,000
„ Switzerland ...	369,000	360,000	— 9,000
„ Other countries ...	172,000	158,000	— 14,000
Total ...	1,589,000	2,617,000	+1,028,000
Dynamo-electric machines weighing more than 1,000 kg.—			
From Austria	110,000	159,000	+ 49,000
„ France	587,000	236,000	— 351,000
„ Germany	5,603,000	4,911,000	— 692,000
„ Great Britain ...	663,000	945,000	+ 282,000
„ Switzerland ...	1,670,000	1,458,000	— 212,000
„ United States ...	358,000	64,000	— 294,000
„ Other countries ...	27,000	236,000	+ 209,000
Total ...	9,018,000	8,009,000	—1,009,000
Ditto, weighing 1,000 kg. or less.—			
From Austria	162,000	106,000	— 56,000
„ France	194,000	160,000	— 34,000
„ Germany	4,670,000	4,685,000	+ 15,000
„ Great Britain ...	200,000	401,000	+ 201,000
„ Switzerland ...	760,000	630,000	— 130,000
„ United States ...	431,000	489,000	+ 58,000
„ Other countries ...	64,000	138,000	+ 74,000
Total ...	6,481,000	6,609,000	+ 128,000
Accumulators and metal parts.—			
From Germany	42,000	15,000	— 27,000
„ Great Britain ...	20,000	12,000	— 8,000
„ Other countries ...	39,000	136,000*	+ 97,000
Total ...	101,000	163,000	+ 62,000

* Holland, 120,000.

	1909. Lire.	1910. Lire.	Increase or decrease. Lire.
Electric transformers.—			
From Austria	752,000	640,000	— 112,000
„ France	207,000	30,000	— 177,000
„ Germany	2,226,000	2,586,000	+ 360,000
„ Great Britain ...	59,000	12,000	— 47,000
„ Switzerland ...	539,000	827,000	+ 288,000
„ United States ...	800,000	—	— 800,000
„ Other countries ...	—	16,000	+ 16,000
Total ...	4,583,000	4,111,000	— 472,000
Parts of dynamo-electric machines and of transformers.—			
From France	202,000	78,000	— 124,000
„ Germany	606,000	632,000	+ 26,000
„ Great Britain ...	100,000	60,000	— 40,000
„ United States ...	344,000	122,000	— 222,000
„ Other countries ...	80,000	161,000	+ 81,000
Total ...	1,332,000	1,053,000	— 279,000
Electrical apparatus.—			
From Germany	1,752,000	2,563,000	+ 811,000
„ Great Britain ...	22,000	138,000	+ 116,000
„ Switzerland ...	248,000	213,000	— 35,000
„ United States ...	292,000	362,000	+ 70,000
„ Other countries ...	171,000	309,000	+ 138,000
Total ...	2,485,000	3,585,000	+1,100,000
Arc lamps.—			
From Germany	459,000	400,000	— 59,000
„ Great Britain ...	2,000	—	— 2,000
„ United States ...	45,000	11,000	— 34,000
„ Other countries ...	47,000	34,000	— 13,000
Total ...	553,000	445,000	— 108,000
Electric lamps, incandescent.—			
From Austria	559,000	615,000	+ 56,000
„ France	130,000	201,000	+ 71,000
„ Germany	1,394,000	1,938,000	+ 544,000
„ Great Britain ...	5,000	7,000	+ 2,000
„ Switzerland ...	64,000	108,000	+ 44,000
„ Other countries ...	71,000	208,000	+ 137,000
Total ...	2,223,000	3,077,000	+ 854,000
Carbons of all kinds for electro-technical purposes.—			
From Austria	223,000	321,000	+ 98,000
„ Germany	611,000	590,000	— 21,000
„ Switzerland ...	35,000	27,000	— 8,000
„ Other countries ...	5,000	10,000	+ 5,000
Total ...	874,000	948,000	+ 74,000

N.B.—25 lire = £1.

PROCEEDINGS OF INSTITUTIONS.

The Faraday Society.

THE MAGNETIC PROPERTIES OF ALLOYS.

The April meeting of the Faraday Society took the form of a general discussion on "The Magnetic Properties of Alloys." Quite a unique collection of papers—some 10 in all—was presented, and among the authors who gave their papers in person, were Dr. E. Gumlich, Director of the Magnetic Department of the Reichsanstalt, Charlottenburg; Dr. E. Wedekind, of Strassburg; and Dr. S. Hilpert, of Berlin. Prof. H. Du Bois, the Kelvin Lecturer for this year, also took part in the discussion, which was presided over by Sir Robert Hadfield, F.R.S., himself a pioneer in this branch of magnetism.

The subject divides itself into two branches, one dealing with the effects of composition and heat treatment on the magnetic qualities of steels and other ferro-alloys, and the other dealing with the properties of the remarkable magnetic non-ferro-alloy of manganese discovered in 1903 by Heusler, who also contributed a paper to the discussion.

The papers on ferro-alloys covered a very wide range of aspects, and only a very brief reference to the scope of the work described will be possible in the limited amount of space here available. Dr. Gumlich's paper dealt with the effects of carbon and silicon on the magnetic properties of irons, and it embodied the preliminary results of a very important series of investigations being carried out at the Reichsanstalt, which will be of considerable interest to the builder of dynamos and transformers. It has been found that the carbon which is *dissolved* in the iron, in solid solution, has the strongest influence upon its magnetic properties, the coercive force increasing proportionally with the dissolved carbon, while the remanence

decreases—an important point as regards permanent magnets. The carbon present as impurity decreases the permeability and increases the hysteresis loss, and hence the maker of dynamo steel and transformer iron, who wants to have his material soft magnetically, has to render the effect of carbon innocuous. This can be done, according to Dr. Gumlich's experiments, by a considerable addition of silicon. Long ago it was discovered by Barrett, Brown, and Hadfield that the addition of silicon to iron diminished its electric conductivity without impairing its magnetic qualities, and it was this work which suggested the experiments made in the Reichsanstalt. Although the part played by the silicon is by no means clear, its effect would appear to be indirect; it seems merely to counteract and eliminate the detrimental effect of the carbon.

The amount of silicon which must be present in order to influence the decomposition of the pearlite, in annealing, into ferrite and temper carbon is from 3 to 4 per cent. Dr. Gumlich thinks that there must be other reasons for the good magnetic qualities of thin iron sheets containing a smaller amount of silicon.

The magnetic properties of a series of nickel and manganese steels, 5 to 33 per cent. nickel, and 5 to 10 per cent. manganese, were dealt with in a paper by Dr. S. Hilpert and Dr. E. Colver-Glavert. The paper considers principally the question of heat treatment, and it should here be remarked that the dependence of magnetic qualities of metals and alloys in heat treatment is quite as great as in the effect of composition. The chairman showed the meeting a piece of manganese steel of uniform composition, which had been treated thermally so as to be magnetic at one end, and non-magnetic at the other. Explanations of the effects of heat treatment largely turn on the validity of the allotropic theory of iron. This theory, which, although generally accepted, is disputed by many eminent metallurgists—including Sir Robert Hadfield—assumes that iron at 750° C. changes into a non-magnetic β form, and at 900° into another non-magnetic alltropic modification, denoted γ iron. It is supposed that all magnetic steels derive their magnetic properties from their content of α iron, but the present experiments of Hilpert and Colver-Glavert, show this cannot be the case, since specimens quenched from 1,240° C., which ought to contain only γ iron were found to be more strongly magnetic than the slowly-ccoled specimen which should consist entirely of α iron.

Again, nearly all the steel tested (the only exception was the 33 per cent. nickel steel, which must be regarded as a special compound), showed a remarkable maximum in magnetic properties by quenching from 900° C. The interesting 25 per cent. nickel steel, which is usually employed when a non-magnetic steel is required, was subjected to very close investigation. In this steel an unmagnetic product is obtained in quenching from about 750° C., and as the temperature rises, a maximum of magnetisability is reached at 900°. The quenched specimens were also cooled as low as —100° C., and at each step measured magnetically at even temperatures; it was found that, with falling temperatures, a gradual increase in magnetisability occurred. The authors were not able to define any connection between magnetic properties and metallographic structure, since steels similar in structure had entirely different magnetic properties, depending on their previous thermal history.

DR. ALEXANDER D. ROSS and DR. JAMES G. GRAY spoke on the magnetic properties of certain special steels at low temperatures. The steels—carbon, nickel, chrome, silicon, tungsten, phosphor, &c. —were tested at some temperature, and when immersed in boiling liquid air, in the conditions brought about by normalising, annealing and quenching the metals at various temperatures. In general, the effect of cooling was to diminish the permeability for low field strengths and to increase it for high fields; a typical magnetisation curve at —190° C. lies initially below and finally above one corresponding to 15° C. The effect is thus the reverse of what takes place when the test piece is heated and is in harmony with Hopkinson's theory of elementary magnets, which regards the iron or steel as made up of permanently magnetic molecules, which become more or less paralleled by magnetic force and whose intensity of magnetisation and polar length vary with the temperature.

PROF. PIERRE WEISS, of Zürich, sent in a study of the magnetic properties of the iron-nickel, iron-cobalt, and nickel-cobalt alloys. Prof. Weiss, from the standpoint of his kinetic theory of ferro-magnetism, regards all metals as homogeneous solid solutions. The saturation intensity is the resultant of the magnetic moments of the molecular magnets, and its value at absolute zero gives the true moment of the molecule, because at that point the disturbing effect of thermal agitation has ceased to exist. In the case of feebly magnetic substances, such as oxygen and the salts of metals, the coefficient of magnetisation is inversely proportional to the absolute temperature. Multiplied by the absolute temperature therefore, this coefficient yields a constant, C, termed the Curie constant, and from this the molecular moment, which cannot be obtained directly in these cases, can be deduced. The feeble magnetisation of ferro-magnetic bodies above the Curie point—at which they lose their strong magnetism—can be deduced from the same constant. Prof. Weiss has found that the varying molecular moments obtained in the case of the same atom under all conditions of temperature and combination have a common measure (1123·5), and, further, this common measure is the same for the atoms of cobalt, manganese, chromium, vanadium, copper, and other elements, so that it appears to be associated with the common elementary magnets. This common moment the author calls the *magneton*, and he has found the conception very useful in studying the alloys of iron, nickel, and cobalt. The results of these researches of Weiss and his students must be given quite briefly. In the case of iron and nickel, the existence of a compound, Fe_3Ni, is indicated. Two uninterrupted series of solid solutions are formed between this compound and iron and nickel respectively. The molecular magnetic moment is additive in the solid solutions, but it ceases to be so in chemical compounds, so that we may have compounds whose magnetism is greater than that of their separate constituents. Measurements made on β iron show that its molecule is Fe_3, that of γ iron Fe_2, and that of δ iron probably Fe. One curious result is that nickel in its reversible ferro alloys is in a state which the pure metal only assumes at a much higher temperature, suggesting a "repercussion" of the neighbouring atoms in the interior magnetic state of the nickel atom. The nickel-cobalt alloys form one uninterrupted series of solid solutions. Cobalt behaves similarly to nickel with respect to its alloys with iron, but the compound Fe_2Co is of special interest, in that at ordinary temperatures it possesses a saturation intensity exceeding that of pure iron by about 10 per cent. Technical applications of this remarkable alloy are under consideration.

Papers on the Hensler alloys were read by Dr. Alexander Ross and Dr. Hilpert, and communicated by Prof. A. A. Knowlton and Dr. O. C. Clifford, of Utah, U.S.A., Dr. E. Take, of Masbury, and by Dr. Hensler himself. The Hensler alloys, which were discovered in 1903, are ferro-magnetic materials built up of constituents which themselves show only the feeblest magnetic qualities, namely, copper, manganese, and aluminium. Binary alloys of manganese with aluminium, tin, antimony, bismuth, boron, and arsenic, are also ferro-magnetic—to a less degree—but they have not been studied in detail, as have the ternary Hensler alloys. Dr. Ross has also studied the copper-manganese with tin, antimony, and bismuth ternary series, and several binary combinations of the above metals. He appears to have taken very special precautions to ensure the purity of the materials employed in making his alloys, a consideration which has been neglected by some workers in this field, and which renders their results more or less untrustworthy. For the methods of making and annealing the alloys and for details of the specially sensitive magnetometer employed, reference must be made to the original papers. The primary object of Dr. Ross's tests was to determine the magnetic quality of the alloys in the condition as cast, to find the best thermal treatment for rendering the metal of good magnetic quality, to test the variation of permeability with temperature, and finally to investigate the effects of annealing and quenching the alloys at various temperatures. The effect on the magnetic quality brought about by cooling the alloys to the temperature of liquid air was found to be in marked opposition to what is found in iron alloys. For example, a typical ternary alloy containing 62 per cent. copper, 25 per cent. manganese and 8 per cent. aluminium, when cooled from 15° C. to — 190° C. showed a considerable increase in permeability for all strengths of field, while a 43·4 per cent. copper, 18·1 per cent. manganese, and 40 per cent. tin alloy had a permeability almost independent of temperature. As already stated, ferro-alloys show enhanced permeability at liquid-air temperature only for high voltages of the applied field. Annealing the alloys at 180° C. improves their magnetic qualities, the best duration of annealing depending on the composition. Quenching the ternary alloys results in diminished permeability and coercive force, except in the bismuth alloys, where the very opposite effect is observed. The quenched alloys after the lapse of some time (accelerated at higher temperatures) undergo a slow transformation by which the permeability returns to its original value, but the hysteresis remains almost at zero.

In the opinion of Dr. Ross, the magnetic experiments, combined with the thermal and microscopic tests, which he described in detail, have proved that the Cu-Mn-Al Hensler alloys are solid solutions of varying concentration, probably consisting Cu_3Al and Mn_3Al, these compounds being the most magnetic members of their respective binary series. Hensler's own theory that ternary magnetic compounds exist, and the alternative theory that the magnetic properties of the alloys are to be ascribed to the occurrence of manganese in a peculiar crystalline form when dissolved in copper and aluminium, are stated by Dr. Ross to be in conflict with his own experimental results. But *why* the feebly magnetic copper, aluminium, and manganese should form magnetic solid solutions of Cu_3Al and Mn_3Al is a problem that still remains to be solved.

The paper on the Hensler alloys, communicated by PROF. A. A. KNOWLTON and DR. O. C. CLIFFORD, of Utah, U.S.A., showed that the percentage composition of these alloys is relatively unimportant as compared with their heat treatment. Thoroughness of mixing in making the alloys, is also an important factor in determining their magnetic qualities, a factor that has been overlooked by many investigators. Of all the alloys made, only some seven, containing from about 60-65 per cent. copper, 25 to 30 per cent. manganese, and 4 to 14 per cent. aluminium, were experimented with, as the mechanical or magnetic properties of the remainder rendered them useless for this purpose. It would appear that under the best conditions of mixing and chilling, the maximum possible induction for a given manganese content, increases with increasing percentage of aluminium. Sensitiveness to heat treatment and magnetic hardness are closely dependent upon the proportion of aluminium present, while the transformation temperatures—at which the alloys lose their magnetic properties—depend largely upon the percentage of copper. On the whole it will be impossible to decide what composition will give the best magnetic alloy until the effects of thermal treatment have been worked out over a wide range of composition. Messrs. Knowlton and Clifford do not accept the assumption of Hensler and Starck that the best results are given by alloys built up of atomic proportion. On the question of the nature of the magnetic units in the Hensler alloys, Knowlton and Clifford seem to incline—not very positively—to the view that these are complex groups, which form the structural elements of a certain type of mixed crystal, and contain at least two different kinds of chemical molecules. This

hypothesis, while broader than that put forward by Dr. Ross, is not in contradiction to Dr. Ross's views.

Dr. E. Tate and Dr. F. Hensler, in their communications, also discussed the various hypotheses regarding the magnetic units in the Hensler alloys. The allotropic theory, first put forward by Faraday and applied in the present connection by Guilleaume, is refuted as not being based on experimental facts. The theory discovers that manganese exists in a magnetic form at a very low temperature in its pure state, but that the transformation temperature is raised by the addition of such metals as alumininium and tin. Hensler's opinion is that complex compounds of the general form $Al_x(Mn.Cu)_{8x}$ exist, and that the molecules of these compounds are the carriers of the strong ferro-magnetism of the aluminium-manganese bronzes. Dr. Ross's hypothesis is substantially the same, but Dr. Hensler's is the more general, and he claims priority, a question which need not be here discussed.

Dr. Tate further considers the very interesting phenomena connected with the "ageing" of the Hensler bronzes. These are in general not magnetic when freshly cast, but they acquire their maximum magnetic intensity by a more or less prolonged heating at high temperatures. Two structural transformations appear to take place, (1) a development of strongly ferro-magnetic elementary magnets, (2) a further rearrangement by virtue of which the free dirigibility of the elementary magnets is more or less impeded in the course of the ageing. It is supposed that the magnetism only becomes manifest when the separate $Al_x(Mn, Cu)_{8x}$ molecules, having been re-formed from desiccated fragments, are further united by segregation from the solid solution with other constituents of the alloy. The intensity of the magnetism will depend on the extent to which these complexes are formed.

Dr. S. Hilpert and Dr. T. Dieckmann spoke on the magnetic properties of the compounds of manganese with phosphorus, arsenic, antimony, and bismuth. The transformation points of these alloys are closely connected with the atomic weights of the elements associated with the manganese. In the case of the phosphide MnP the transformation point is so low (18-25°) that if the compound be warmed with the hand it no longer reacts with a magnet, but immediately does so if placed in cold water. This was experimentally demonstrated.

The last contribution to the discussion which we have to notice is that of Prof. E. Wedekind, who spoke on the relations between the magnetism and the constitution of chemical compounds. The elements which form ferro-magnetic substances in their compounds may be divided into two classes, the ferro-magnetic metals themselves—iron, nickel and cobalt—and the metals which are themselves feebly paramagnetic, and which form compounds more or less ferro-magnetic. These elements—manganese, chromium, vanadium, titanium, among others—may be said to possess "latent magnetism." The magnetism of compounds of the ferro-magnetic metals is essentially feebler than that of the metal. On the other hand, in the case of the metals possessing "latent" magnetism, their simple compounds are, as a rule, more strongly magnetic than the metals, the susceptibility of the various compounds depending on the *valency* of the metal in the particular compound in question. On the whole, the magnetic susceptibility decreases with decreasing atomic weight of the chief metal. Thus several manganese compounds are ferro-magnetic; in the case of chromium, only the two mixed oxides are ferro-magnetic, while none of the vanadium compounds are very decidedly magnetic. An interesting group of magnetic compounds, which have hardly at present been investigated, are the oxides of the rare earths, neodymium, eucopium, gandolinuim, terbrium, and dysprosium. These show extraordinarily high magnetic values, which appear to depend not, as in the above cases on the valency, but on the atomic weights of the metallic constituents.

High-Frequency Currents.

High-frequency currents formed the subject of the Friday evening lecture at the Royal Institution on May 17th, the lecturer being Mr. W. Duddell, F.R.S. After an elementary description of the meaning of electrical frequencies, which was graphically illustrated by the writing of a pendulum on a piece of smoked glass as it passed through the lantern, Mr. Duddell devoted the greater part of his hour to considering the three main groups of methods for generating high frequencies. The first of these was the alternator method; the second depended on the discharge of the Leyden jar; the third, on the properties of the electric arc. In his opinion the alternator method was the one most likely to develop in importance in the near future. He had himself lately constructed a little machine to give 2,000 frequencies. It had 15 magnets, and the circumference of the disk when rotating covered something like three miles per minute. This machine was not brought on view, but a telephone in the lecture theatre was connected with the basement in which it was installed, and with this it was possible to realise the increasing frequency by the shrillness of the note, the telephone failing to respond when the machine reached the higher frequencies of which it was capable. For high frequencies proper, that is to say, periodicities of 10,000 cycles per second and upwards, he drew attention by means of photographs to one American and one German construction, the former a recent 100,000-cycle alternator, with a 400 and 600-slot winding, with which a frequency of 200,000 was possible; and the latter, the machine of Dr. Goldschmidt, with a method of stepping-up the frequency, electrically or magnetically, by short-circuitings of the rotating part. He was confident that there was a great future before the high-frequency alternator. Only a brief description was given of the method of generating high-frequency current by means of a Leyden jar, and Mr. Duddell then passed on to describe the arc method, in which advantage was taken of the instability of the arc to produce rapidly alternating current. He demonstrated in this connection the use of the Tesla coil with an arc burning in air between two carbon electrodes, and also showed Poulsen's method of immersing the arc in coal-gas, and, in order to make it still more unstable, using a very powerful magnetic field. With an apparatus of this sort Mr. Poulsen had succeeded in transmitting 100 words a minute in wireless telegraphy over a thousand miles. A number of beautiful experiments, such as the lighting-up of vacuum tubes when brought into this field, were shown, and a remarkable phenomenon, which he had not himself noted until his attention was called to it the same afternoon by Sir James Dewar, was the gradual luminosity and utimate red-heat of a carbon filament lamp when placed at the top of the coil. With a metal-filament the effect was not obtained, and the formation of carbon dioxide in the lamp appeared to play an essential part in its production. In concluding, Mr. Duddell showed the simple high-frequency method of Mr. S. G. Brown, in which an oscillating current was in parallel with a constant current circuit, the current flowing to a rotating disk of aluminium from a small copper block, which was lightly pressed against the edge of the disk. He added that the choice between the different methods would depend upon their respective reliability in practice, and upon the cost of generating the high-frequency current.

The Corrugation of Rails.

By Prof. Alfred Schwartz, M.I.E.E., and R. G. Cunliffe, M.Sc.Tech., A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, *at Manchester, March 26th*, 1912.)

Experiments were carried out with a view to affording some indication of the extent to which "slip" and "skid" take place with trailed wheels under various conditions of load and track. A model Brill truck to a scale of $\frac{1}{10}$ was employed, with a recording device. It was found that on curves from 2 to 15 ft. radius, the increment of slip or skid per revolution was practically constant for a given curve.

Wheels of equal diameters passing round curves of 2 to 15 ft. radius, and wheels of unequal diameters were employed on straight track and on curves of radius of 2 to 15 ft.

In every case the skid of a wheel on the outer rail of a curve is greater than the slip on its mate wheel; this is due to the additional skid produced by the action of the flange.

Experiments were made on the cold flow of metals due to rubbing and hammering. A cast lead disk 9 in. in diameter and 1 in. thick was turned true on the sides and edges. A brass cylinder 1 in. in diameter and 2 in. long was pinned to one end of a steel arm 6 in. long, in such a way that the cylinder could not rotate. The cylinder rested upon the edge of the lead disk with the centre of the cylinder vertically above the centre of the disk, the cylinder being free to rise and fall. The disk was then rotated in the lathe at a peripheral speed of 10 miles per hour. After running in this way for a short time, it was found that the cylinder appeared to be "floating" above the edge of the disk, the gap between the cylinder and the disk being marked by a persistent line of light. This effect was produced by the rapid rise and fall of the cylinder in its passage over the minute irregularities on the surface of the disk. Its amplitude rapidly increased as the experiment progressed, and finally resulted in the cylinder movement resolving itself into a series of jumps, the average height of these jumps at the conclusion of the experiments being about 3 to 4 in. above the surface of the disk.

After running for a few minutes, the edge of the disk was found to be covered with a number of abrasions of somewhat irregular pitch. These abrasions were formed by the surface of the metal being pushed forward in certain places, thus forming slight elevations or ridges which were perceptible to sight and touch. In consequence of these ridges the jumping of the cylinder now became considerable, and the surface of the metal was rapidly displaced owing to the hammering produced by the successive blows of the cylinder. This action was continued until the edge of the disk was strongly marked with corrugation of somewhat irregular pitch.

The fixed rubbing cylinder was now replaced by a cylinder of the same diameter, which was capable of rotating freely on an axle. The time occupied in obtaining corrugation of a given size was very much longer with the rotating cylinder than with the fixed one.

It was decided to cause the rubbing cylinder to jump once in each revolution by placing an artificial obstacle on the edge of the disk.

A deep indentation was caused by the rubbing cylinder striking the disk immediately after its jump, and smaller indentations due to the vibrations set up in the arm on which the rubbing cylinder was carried.

A straight bar of cast lead carefully machined on the sides and edges was employed, and arrangements were made whereby the bar was rubbed in one direction only by a steel cylinder which did not rotate.

After three minutes' rubbing with the fixed cylinder, the surface of the lead bar was covered with corrugation of short pitch, and as the rubbing proceeded, the pitch and depth of the corrugation progressively increased; when the rubbing cylinder and the lead bar were well lubricated with oil throughout the experiment, the effect was extremely small compared with the results obtained without lubrication.

A steel cylinder capable of rotating freely on a steel axle was substituted for the fixed rubbing cylinder, and results were obtained identical in their main features with those obtained with the fixed

rubbing cylinder under similar conditions. The time required to produce corrugation of a given size was, however, very much longer in the case of the cylinder that was free to rotate than that required with the fixed cylinder.

In the case of lead, the metal is pushed forward, and piled up in front of the point of impact, and the tops of the crests thus formed are higher than the original surface of the bar. The hollows are lower than the original surface of the bar owing to metal having been pushed forward from them to form the crests, and to fins of metal being extended at the sides of the bar due to the hammering of the cylinder.

With lead, it was found that there was a limit to the height to which the crests were raised above the original surface of the rail, since, after a certain point was reached, there was not sufficient cohesion between the various layers of metal which had been pushed forward, to hold them in position, and large and small flakes were removed at frequent intervals by the rubbing cylinder.

A bar of yellow pine was substituted for the lead with a view to trying the effect on a material, the surface of which did not lend itself readily to horizontal displacement, and yet would be sufficiently soft to show the effect of hammering.

In this case the hollows of the corrugations were beaten out within the limits set by the transverse vibrations of the connecting rod, the crests remaining at the level of the original surface of the bar. The rubbing cylinder was, to begin with, only bearing on one edge of the wood bar, and as the hollows increased in depth the bearing of the cylinder was increased until it extended right across the bar at the deepest parts of the hollows. This same formation is frequently found in corrugation on the track.

In the previous experiments the average speed of the rubbing cylinder was 200 ft. per minute; this was now reduced to 80 ft. per minute, with the result that the corrugation developed more slowly, and was very much altered in character. The pitch increased with time, but the amplitude of the corrugation did not increase proportionately, and remained extremely small.

For the purpose of experiment and observation on the tramway track a portable apparatus was constructed for obtaining longitudinal profiles of corrugations with a vertical magnification of 10 to 40 times and a natural horizontal scale. By this means it was found that the corrugation was, in general, irregular both as to pitch and amplitude, and that the crests of the corrugations were at the general level of the rail head, while the hollows were below this level. Plaster casts of corrugation were obtained from the rails *in situ;* from a consideration of these casts, and a comparison with the original sections of the new rails, it was found that metal was extruded both on the inner and outer side of the rail head, and that in many places the outer side of the rail head was much worn by the vehicular traffic.

To obtain graphical records of the pitch and shape of the corrugations in plan, a strip of thin tough paper was laid along the rail tread and drawn tight; it was then rubbed on its upper surface with a wooden rubber coated with blacklead. Preparatory to taking a record, the rail head was first carefully cleaned by means of a metal scraper, followed by a stiff wire brush; and was finally polished with a dry cloth. Graphic records were obtained in this way from a large number of typical portions of electric tramway tracks, from main line steam tracks, and from the running rails and conductor rails (third rails) of electric railways. In making these rubbings care must be taken to keep the paper strip stretched taut; if it is at all loose it is liable to cockle under the rubber, and to give rise to alternate light and dark patches of short pitch, which might be mistaken for corrugations.

Experiments were also made on the track designed to record the variation in pressure between the wheels and the rails under service conditions. A length of rail tread was coated with graphite, and polished bright; a paper strip was placed over this length, which was pressed upon the blackleaded rail surface by the wheel in its passage over it. In taking a record a paper strip about 4 in. wide was pinned lengthwise along one edge of a thin wood board, so that the paper projected about 3 in. beyond the edge of the board throughout its length. The projecting portion of the paper was laid over the tread of the rail with its outer edge coincident with the gauge edge of the rail. It was found quite easy to obtain a record from the leading wheel of a car by pulling back the board before the second wheel reached the paper.

In general, corrugation appears on the running rails of cable, steam, and electric traction systems. We have found pronounced corrugation on the rails of each of the five steam railway systems which we have examined in this country, but it is not present on steam or cable lines to nearly so serious an extent as it is on electric lines. The third rails of electric railways with sliding collector shoes are frequently extensively corrugated. The trolley wire of tramway systems is often corrugated for short lengths at bridge, bracket arm, or span supports, and for considerable lengths of the suspended wire between the supports.

Parts of machines making sliding or rolling contacts are frequently corrugated when there is some freedom of motion of one or other of the parts concerned at right angles to the surface rubbed. We have noticed corrugation on the collector rings of alternators, and while, no doubt, the burning due to sparking when the contact is broken affects the result, we regard this as an effect rather than as the cause of the corrugation.

Corrugation in trolley wires frequently shows "pitting," due to arcing in the hollows caused by the jumping of the trolley wheel on the crests.

Fig. 2 shows rubbings taken from the track of the Manchester Corporation tramways, as follows:—

A, 40.-ft. curve, outer rail; B, 40-ft. curve, inner rail.

The rails of sharp curves such as these are generally free from corrugation. The wheels of cars passing round sharp curves are continually binding in rail grooves, with the result that the car body, truck, and driving elements are locked together, and the vertical movements of the wheels are damped.

C. Outer rail of flat curve of very large radius. D. Inner rail, opposite to C.

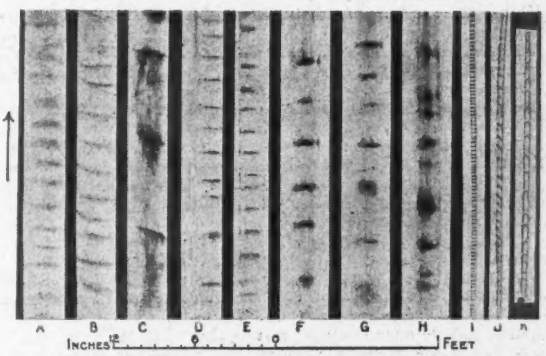
The radius of curvature is not uniform, the track following the curvature of the road, but in no place being less than 1,000 ft. The record D shows long corrugations on the inner rail.

E. Outer rail of flat curve. F. Inner rail, opposite to E.

The record F shows both long and short corrugations on the inner rail.

G. Straight track, cars in one direction only as is usual practice.

In this case the coned wheels run on a horizontal rail tread and bear at first on the gauge end of the rail.



City and South London Railway—A, B, C, collector rails; A, running dead slow just before stop, current about 5 amperes; B, running slow, accelerating, current about 280 amperes; C, running fast, coasting, current about 5 amperes; D and E, C. & S.L. Railway, running rails; F, G and H, running rails, main-line steam track, Manchester; I, trolley wire, Manchester Corporation tramways, between supports; J, trolley wire under the ear at a span support, flexible in a vertical plane; K, trolley wire under the ear at a support used in passing under bridges.

Fig. 1.

H. Similar rail on the same route with contact between wheels and rail and at middle of rail tread.

I. Straight track, traffic in both directions equally. Gauge edge contact between wheels and rail.

J. Rail opposite to I, at the same place, showing approximate agreement between corrugations. Complete wheel contact.

A consideration of the experiments appears to show that the corrugation is initiated by the action of one or more of the following forces:—

(*a*) Jumping of the moving system on its passage over minute irregularities of the surface, or over an obstacle of some magnitude, when the critical speed is exceeded.

(*b*) Abrasion and displacement of the surface due to the difference between the static and dynamic coefficients of friction of the surfaces in contact.

(*c*) The longitudinal vibrations of the moving system.

(*d*) The transverse vibrations of the moving system.

In the case of a metal like lead the surface material is easily pushed forward, and the principal factor in initiating the corrugation would appear to be the abrasion of the surface and the progressive longitudinial displacement of metal, due to the great

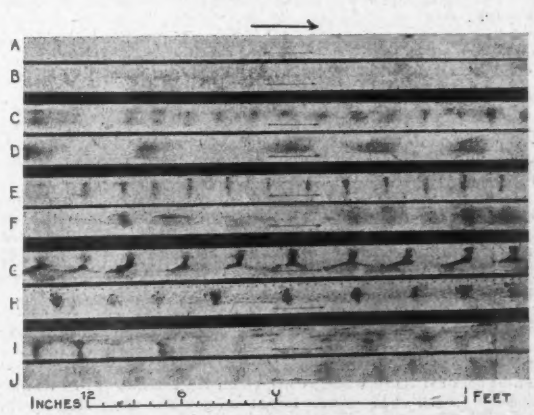


Fig. 2.

difference existing between the static and the dynamic coefficients of friction.

The main factor influencing the growth and also the spread of the corrugation is the hammering due to the jumping of the rubbing cylinder; in general the other factors may be regarded as

being subordinate to this, and as affecting the form of the corrugation produced, and its degree of regularity.

The authors distinguish two classes of corrugation on the tramway track which they term "visible" and "invisible" respectively, according as the corrugations are visible to the naked eye or not. The presence of the invisible corrugation may be determined by means of graphite rubbings.

Invisible corrugation does not appear to give rise to annoyance or trouble in practice to any extent; it increases very slowly, and may even reach a condition of equilibrium with respect to the general wear of the rail.

The main facts relating to visible corrugation are well known. The inner rails of flat curves are generally less strongly corrugated than the outer rails, and the pitch in many cases is longer than that on the outer rails, but in some cases the pitch on both rails is equal, and the crests and hollows occupy corresponding positions on the two rails.

Visible corrugation on the track appears to be due to a combination of forces similar to those operating in the formation of corrugation on the lead bars, in which progressive longitudinal displacement of the metal is brought about by the joint action of the forces concerned.

The specific pressure on the area of contact will be a maximum when the flange of a given wheel is against the rail head, and with coned wheels on a flat rail tread the bearing surface will be close to the gauge edge of the rail where, as pointed out by Beaumont, the metal is not held *encastrée*. The result will be that the wheels of the car travelling on the outside rail of a curve will have the maximum value for the specific pressure on the area of contact, and the tendency to jump will be increased by the climbing action of the flange.

With regard to corrugation on the inner rails of curves, it appears to the authors that where this agrees in pitch and position with that on the outer rails, it is a case of transference of the impulses derived from the outer rail to the inner rail by means of the axle. In this connection it may be observed that, although the wheels on the outer rails frequently break contact with the rails when "jumping," we have not yet observed this to be the case with the inside wheels, the results showing variation in pressure on the contact only. As already stated, the presence or absence of continuity of contact between the wheel and rail profoundly modifies the character of the corrugation produced and its rate of growth.

The characteristics of corrugation on the straight are precisely the same as those of the visible corrugation on the outer rails of flat curves. Our conclusions with regard to visible corrugation on the straight are as follows:—The visible corrugation is probably an augmentation of the invisible corrugation of short pitch present at almost all parts of the track. This augmentation may be due to variation in the specific pressure on the contact area between wheels and rail due to the position of the wheel flange relative to the rail. The position of the flange in the groove will vary with the following conditions:—

1. A constant contact of the flange of one wheel with the check or gauge edge may be caused by unequal diameters of the wheels. Owing to the prevalence of curves in one direction on a given route, and the use of particular cars on given routes, it is not infrequent to find the wheel diameters on one side of a car persistently greater or less than those on the other side.

2. An intermittent contact of the flange of one wheel with the check or gauge edge may be caused by differences between the coefficient of friction of the two rails. The wheel on which the friction is greatest will tend to lead and will throw the flange of its mate wheel against the gauge edge of the rail; this will increase the friction on the mate wheel, which will then lead, and these alternations in lead will continue possibly with high frequency.

In the event of the tire or groove wear allowing the flange of either wheel to come in contact with the check, the above-mentioned alternations will be set up and corrugation of the check may result.

The flange action referred to may set up skid and a tendency in the wheel to climb the rail, thus giving rise to corrugation.

Discussion.

Mr. J. Prescott said he could not come to any definite conclusion as to whether corrugations were caused by vibration or not. Calculations on a Brill truck showed that the oscillations due to the spring system could not produce the well-known corrugations of 2 and 3 in. pitch on tramrails. It did not follow, however, that oscillations were not the cause, as many parts of a truck could vibrate besides the springs, and it would need an accurate knowledge of the rigidity of the parts in order to decide whether oscillations of the right period were possible.

Dr. E. W. Marchant referred to the question of how far corrugation was caused by the flexibility of the wheels and axles. Corrugation appeared to be due mainly to driving wheels. The corrugation due to steam trains was not so large as on electric tramways because the number of driving wheels compared with the number of trailers was very small. The effect might be got rid of by making the wheels and axles stiffer than at present.

Mr. D. Harrop said that amongst the many variable factors causing corrugations were the actual circumstances peculiar to local conditions, such as the nature of substructure of track, concrete foundations, &c. This might not be a fundamental but a contributory cause.

Mr. J. Frith said that one of the valuable points about the paper was to disprove almost every theory that had hitherto been put forward regarding rail corrugation. For example, the theory of the teeth of the gearing and the theory of high axle pressure had weak points when the matter in the paper was applied. One conclusion seemed evident, viz.: That there must always be a tendency to corrugate when there was relative motion.

Mr. W. Cramp (chairman) said the corrugations shown were, to some extent, similar to those found in the work which had been done with fluids on sand. These experiments were sufficient to account for the fact that initial bumps on a rail would produce continuous corrugation. The most important deduction from the paper had already been mentioned by Mr. Frith, viz.:—That any single explanation put forward seemed to fail in some particular, therefore the cause was probably complex, each suggestion being a partial truth. It should be possible to free the rail from bumps, and then observe whether corrugation appeared more slowly, in a different manner, or not at all. If corrugations were set up by the pushing over of metal, or even by hammering such as would occur by the oscillation of a car, it would seem that the rails when examined by a microscope would appear in the hollows to be harder and closer grained than at the crests.

Mr. R. G. Parrott said there seemed to be some critical relative speed between the wheel and rail at which corrugation began to form rapidly. It would be of interest to know if the pitch of the corrugations remained constant under varying conditions. He had observed on a straight tramway track a series of corrugations alternately on the left and right-hand rail.

Mr. C. F. Ellwood said he had noticed on a straight stretch of Manchester tramway track, a series of longitudinal scratches nearly parallel with the rail edge. These scratches or abrasions were due to either slip or skid, and were in his opinion incipient corrugations. The scratches were two to three inches long and in patches. The action of a jumping wheel alighting is to produce skid or slip, perhaps both, and the foregoing observations seemed to bear out the authors' contentions regarding causes of corrugations. The marks referred to by Mr. Prescott might be observed on short-radius curves transversely across the track, but the wheel records given by the authors were actually due to corrugation.

The Institution of Electrical Engineers.

The Report of the Council and statement of accounts for 1911 were presented and adopted at the annual general meeting on Thursday last week. The membership now consists of seven Hon. Members, 1,388 Members, 3,089 Associate Members, 806 Associates, and 1,247 Students—total, 6,537; the gross increase amounts to 685, and the net increase to 304, compared with an average annual increase of 105 during the last five years. A Salomons Scholarship has been awarded to Mr. R. J. Webb, of King's College, and a David Hughes Scholarship to Mr. D. Dunham, of the City and Guilds (Engineering) College, South Kensington. The Institution Premium has been awarded to Dr. J. A. Fleming and Mr. G. B. Dyke; the Ayrton Premium to Mr. J. Lustgarten; the Fahie Premium to Mr. W. Aitken; the John Hopkinson Premium to Messrs. H. D. Symons and Miles Walker; the Kelvin Premium to Mr. E. H. Rayner; the Paris Electrical Exhibition Premium to Mr. R. J. Roberts; and an extra premium to Messrs. S. W. Melsom and H. C. Booth, for papers read before the Institution. Students' Premiums have been awarded to Messrs. E. W. Moss and J. Mould, E. T. Pannell, E. T. Caparn, R. G. Parrott, and P. R. Coursey and G. G. Dawson.

The International Radio-Telegraphic Conference will be held at the Institution Buildings in June and July.

A sum of £500 has been allocated to the provision of apparatus to enable authors to illustrate their papers by experiments. The Wiring Rules have been adopted by some 50 Fire Offices and 232 supply authorities; more than 8,000 copies have been sold, and they have been reprinted in many hand-books. A scheme is under consideration for the examination and certification of wiremen. An "Industrial Committee" is to be appointed to report on all industrial matters in respect of which the Institution might usefully take action, besides taking over the work of the Parliamentary Committee; the Committee will also on occasion arrange for special meetings of various branches of the electrical industry. The Benevolent Fund shows a satisfactory increase, the capital account on December 31st, 1911, standing at £4,000.

The report of the hon. treasurer, Mr. Robert Hammond, shows that the margin to the good on the revenue account is £1,274, as compared with £3,053 in the previous year, a decrease of £1,779; the current expenditure was £13,763, and the year's revenue £15,037. Books and furniture have further absorbed £357, and repayment of mortgage on the Institution building, £626. The assets amount to £101,739, against liabilities £39,335, leaving a margin to the good of £62,404, an improvement of £2,569; of this increase, entrance fees account for £929—a record in the history of the Institution—and life compositions for £223. The Life Compositions Fund stands at £5,866, and under the revised Articles this sum will be freed for transfer to the general fund.

Hornchurch and Upminster.—Mr. W. Ivey, of London, has informed the Romford R.D.C. that he proposes to apply for powers to supply electricity for all purposes in the parishes of Hornchurch and Upminster, and has asked for the consent and support of the Council. Mr. Ivey has been requested to furnish more definite particulars of the scheme prior to interviewing the Council.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

On Advertising Methods.

May I avail myself of the columns of your journal to suggest to certain electrical manufacturers that it would be much to their interest if they refrained from endorsing envelopes "Private," which contain nothing more important than circular letters and pamphlets describing certain of their manufactures?

It often happens that certain of these letters are forwarded on to one, after no little time has been wasted in judging whether they are really of a private nature or otherwise.

I think this is a practice more worthy of some quack medicine or money-lending concern than of a firm carrying on the sober business of electrical manufacturers. Any literature received by me under such conditions is very quickly relegated to the waste-paper basket.

I enclose my card, and subscribe myself,

Disgusted.

The Domestic Uses of Electricity.

The recent discussions at the Institution have emphasised, after unsuitable tariffs, chiefly three main factors as acting against the efficient development of the electrical industry, these being inefficient and insufficient advertisement, mutual recrimination instead of co-operation between the supply people and electrical contractors, and the harm that has been and is being done by the sale of apparatus not properly designed or made for everyday use.

It is to be hoped that matters do not end with the discussion or its utility will be doubtful.

Dealing with the last point first, Mr. Vesey Brown's suggestion that no apparatus should be allowed till it had passed what one is tempted to call "the committee for the suppression of electrical development," obviously overshoots the mark, but it contains, I think, the germ of a good suggestion. Without going so far as Mr. Brown suggests, I think it is an opportune time for the Institution to take a leaf out of the book of the R.A.C., and issue certificates of performance of apparatus submitted to them that satisfies them as to its usefulness.

Features it would be advisable to embody would be a description of the apparatus for the purpose of identification, claims made for it, and the results of the Institution tests.

Makers or vendors should not be allowed to advertise the obtaining of the Institution certificate with any claims, other than those tested by the Institution, added. These certificates, therefore, would form a sort of hall mark, rendering the introduction of new satisfactory apparatus easy, and at the same time protecting users from apparatus that will not fulfil its claims.

The case of the contractors and a good part of the advertising problems, it seems to me, might be solved together. The contractors have long been called "unpaid canvassers" to the supply people, and to this I would like to repeat the substance of some remarks made by Mr. Seabrook during the discussion of Messrs. Macfarlane and Burge's paper, which were much appreciated at the time. Referring to the cost of developing and marketing new applications, he remarked that the supply companies might well do more than they did towards this, since they had most to gain—the makers and vendors made only one profit, whilst the supply people obtained a continuous revenue.

Taking the case of the contractor, this means that for every shilling profit he puts in his own pocket, he puts several (say, five) shillings into the pocket of the supply people. To balance this, when the supply people make a shilling profit, do they put five shillings into the pockets of the contractors?

Personally, I think they wish to go at any rate part of the way, but there is the Committee to think of, which bars out most arrangements.

The suggestion I have to make is this:—The electric supply authority to equip and maintain commodious central premises, containing a permanent exhibition of, as far as practicable, every electrical appliance suitable for use on their circuit, with facilities to demonstrate their use.

Essential features it appears desirable to have in the scheme would be, (1) prominently displayed the name and address of every electrical contractor in their area, except any known to be incompetent or to do bad work; (2) no goods to be sold in the Exhibition; (3) when the supply people have a contracting department, this to be kept clear away from the premises, and their officials only allowed in during public hours when with a client, and to have no precedence over outside contractors.

A centre like this could have a much bigger range of appliances than any single contractor could accommodate, and manufacturers would in many cases loan goods which they would not do to individual contractors, and the scheme generally would promote co-operation between the contractors and supply people, which, in turn, would go a long way to removing present differences, which are four-fifths misunderstanding and only one-fifth based on realities, only needing the parties to get together, with a determination to settle the differences, to disappear.

W. E. Burnand.

Sheffield, *May 14th*, 1912.

E.A.C. Automatic Solenoid Starter.

I was much interested in reading the description and seeing the illustrations in your issue of the 10th inst., of the new automatic solenoid starter brought out by the Electrical Apparatus Co., Ltd., as for some time past it has been one of my hobbies to attempt to improve this class of apparatus. It is, however, very difficult to hit upon anything which is really novel, because it is inevitable that people working on the same problems should hit upon similar methods of solving them, and I have frequently found that little improvements which I thought were novel have been devised and patented years before. I think that this applies also to the new automatic solenoid starter described, as a precisely similar arrangement is shown in my Patent No. 20,369 of the year 1906, namely, a single solenoid starter in which the main switch is pulled in by a short core at the top of the solenoid, and the rheostat lever is drawn up against the dash-pot by a core at the bottom of the solenoid. This is only one of many arrangements shown in the patent referred to, which you will see is almost six years old.

Frank Broadbent.

London, E.C., *May 21st*, 1912.

P.S.—The sole manufacturing rights in connection with the above patent were assigned to the Adams Manufacturing Co. some few years ago.

Colonial References.

May we be allowed the use of your valuable space to corroborate the views put forward with reference to South Africa by "Colonial," in your issue of March 29th.

The trouble, we think, may be said to have started during the time of, or shortly after the close of, the Boer War.

Employers and mine managers were thirsting for electrical men, and anyone who knew, or professed to know, the difference between a voltmeter and a switch was received with open arms, and the choice of many jobs at a minimum wage of £1 per day.

The consequence is that these men have gradually, by dint of perseverance and, incidentally, much damage to their employers' plant, picked up a certain amount of knowledge, and in the majority of cases they occupy good positions with excellent salaries. During the past year or two many trained engineers have been imported from "home" to large power schemes on the Rand.

Dazzled by promises of salaries magnificent compared with the home standard, and the assurance that their lives out here would be made a little "Heaven on earth," they are bitterly disappointed when they learn the real truth of the matter. In some cases the men discover, too

late, that they are being paid less than the standard rate of pay of the mines with very little prospect of any increase. Apart from this they are so hedged about with petty rules and regulations that the vision of South Africa as the "Promised land" quickly fades, and their one object resolves itself into saving a little money and getting away somewhere else as soon as possible. Again, is it fair that men should be signed on for a period of three years, and, after working for some months, should be forced to sign an entirely new agreement rendering them liable to be sacked at a month's notice, with the prospect of being stranded in Africa? Until some change is made in the method of bringing men out here, and in the manner of treating them when they arrive, there will always be a scarcity of trained power station engineers on the Rand.

Ex-Contract Men.

The article under the above title in your March 29th number was so evidently written by a young, very young, engineer, that your footnote was quite unnecessary.

It reminds one of the young man who, when he left school, thought his father completely ignorant. As he grew older he acknowledged that his father did know something, and when at last he came to years of discretion he was obliged to admit that the "old man" knew considerably more than he did himself!

Referring to the article by "Colonial," he says: "Many Colonial engineers do not know their work—merely self-taught, and not entitled to be called professional men at all, &c." *All* pioneers are self-taught.

Who taught Edison, Sir William Preece, F.R.S., Sir John Gavey, in fact all the original leaders in our profession? It is just these self-taught men who teach the younger generation what they themselves, by study and experience, have learnt.

Sir William Preece used to say that the principal object of schools and colleges was to teach their pupils how to instruct themselves, for in all professions one must be continually learning, or otherwise be shortly out of date.

Who were the original chiefs of the electrical world in South Africa? Presidents of the South African Section of the Institution of Electrical Engineers? Men of the writer's time who went out long before telephones or electric light (and possibly "Colonial") were ever thought of. These were the men who introduced the electric light, &c., who were, and are, no doubt, quite up to date.

"Colonial" apparently has a very high opinion of "Home Engineers." We are sure that no one wishes to destroy this good opinion, but to insinuate that they are the *only* engineers, is a little too sweeping.

Conditions in England, a thickly-populated country, are very different from those abroad in new and sparsely-populated countries.

What at first sight appears to a "Home Engineer" to be a very untidy and badly-arranged installation, may be just what is required to meet the case.

Why did the electric light, telephones, and electric tramways go ahead so fast in the United States? Simply because there, as in most new countries, they were not hampered by "Home Engineers," who either would do the work "just so," as they had been taught, or would do nothing at all.

The writer well remembers how horrified he was when he first saw the original arc lighting wires in New York. Telephone wires of the then unusual small gauge, with abnormally long spans, and not a joint soldered, also shocked him, who was accustomed to the high-class English Post Office standard; but this rough work was cheap, and allowed installations to be made and experience gained.

Railways, again, in nearly all new countries, are simply astounding to "Home Engineers." Many times on a narrow-gauge railway here, after running at 30 miles an hour or more round curves of 150 metres radius, over rails merely spiked down, "Home Engineer" friends of the writer have refused to continue the journey beyond the first station, alleging danger. Yet the American bogie engine with a bar frame, which twists about like a basket, continues to run safely over this kind of track. Nowadays English engines are to be obtained built on these lines, but the "Home Engineer" learnt his lesson from the "Colonial."

Where did the three-phase high-tension come from? It was employed and brought to perfection long before "home engineers" appreciated it. In fact, many years ago the present writer recommended it for an installation in which he was interested. His opinion was squashed by some well-known consulting engineers, but at the present day the three-phase, then tabooed, is employed.

"Colonial" recommends examinations as a panacea for his imagined evils. This is a very vexed question, and the writer, from his experience, does not concur with the efficiency of this system. It is well known that many, if not most, famous men would have made a poor figure in examinations. Any man with a good memory can cram and pass with the greatest ease any examination, and yet he may be quite worthless for anything else.

When electric tramways were in their infancy the writer saw all there was to be seen in England, where the best engineers of the day (probably most of whom had passed excellent examinations) were occupied in the work. Everyone knows what troubles arose. Returning to this country (which shall be nameless, as it is of no consequence), the writer saw the installation of a very large tramway system by an American company.

There were specialists for each section of the work, for pole-setting, wiring, rail-laying, &c. Never was work better done according to the knowledge of that time. Everything went like clockwork, no burnt motors, no derailments, no breakdown. The men who did this work were classed by their American compatriots as cowboys! and an examination, as desired by "Colonial," would not only have "weeded out scores," but the whole lot of these excellent men.

The writer has made joints with his own hands over and over again, has cleaned batteries, repaired apparatus of every description, and although consulting engineer to important companies, does not consider that he has "lowered his status" by so doing.

In a new country an engineer should be prepared not only to order work, but also to show how it must be done. The above is not one tithe of what could be written in connection with the sweeping condemnation by "Colonial" of all that is Colonial or foreign, but your space has already been too much trespassed upon.

After a little more experience our friend "Colonial" will, no doubt, give justice where it is due, and will find that in spite of his home experience, he will be able to learn quite a good deal from the self-educated Colonial whose Bible has probably been the Electrical Review, as it has been since No. 1 to

M.I.E.E.

"Nickel Chrome" has omitted to send his address.

Co-partnership.—At the annual meeting of the Labour Co-partnership Association last week, Lord Grey said the events of the last year had forced the nation to realise that it was necessary to set its industrial house in order. The objects of the Association were to secure industrial peace, to promote industrial efficiency, to raise wages to the highest point which the industry could afford, and to ennoble and dignify the *status* of the manual worker. He did not claim that co-partnership principles could be at present universally applied, but he did contend that, wherever co-partnership principles were applied under right conditions, the cost of production would be lessened and the possibilities of profit increased to the benefit of the capitalist, the worker, and the consumer.—*Times.*

Galloways, Ltd.—According to the *Financial Times*, the affairs of this Manchester firm of boilermakers and engineers have, with the consent of the Deputy Chancellor of the Duchy of Lancaster, been placed in the hands of Mr. Alfred H. Pownall, chartered accountant, of Manchester, who will act as receiver and manager, and carry on the business. "The motion was made, on the application of Sir Frederick Cawley and Mr. Charles Leonard Agnew, on behalf of themselves and all other debenture holders who opposed the prospective issue of £50,000 prior lien debentures. The deficiency on last year's trading is stated to be heavy."

The Whitsun Holidays.—The Walsall Electrical Co., Ltd., of Walsall, announce that their works will be closed from to-night, 24th inst., until Thursday morning, May 30th, for the holidays.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

The "Flotteur" Sight-feed Lubricator.

The Stern Sonneborn Oil Co., Ltd., of Finsbury Square, E.C., have recently introduced a new sight-feed oil lubricator, which, as regards accuracy of adjustment and precision of lubrication, is claimed to be considerably in advance of anything hitherto obtainable.

The "Flotteur" lubricator depends for its action on the suction of the syphon, which takes its supply from the surface of the oil,

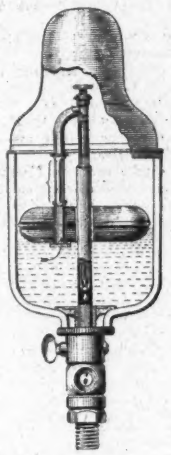


Fig. 1.—"Flotteur" Lubricator.

and is therefore efficient, entirely independent of the height at which the oil may be standing in the container.

The oil flow is regulated by adjusting the suction pipe and size of outflow opening, and a thermoscopic arrangement is provided to make this free of temperature change.

This lubricator will automatically supply a somewhat larger amount of oil when required by the bearings of a machine just starting up; it is absolutely dustproof when closed, and feeds only the clear surface oil, any sediment falling to the bottom of the container.

"Metallic" Fuseboards.

The distributing board here illustrated is made by the Metallic Seamless Tube Co., Ltd., of Birmingham; as shown, it is enclosed in an iron case, fitted with independent doors for fuses and

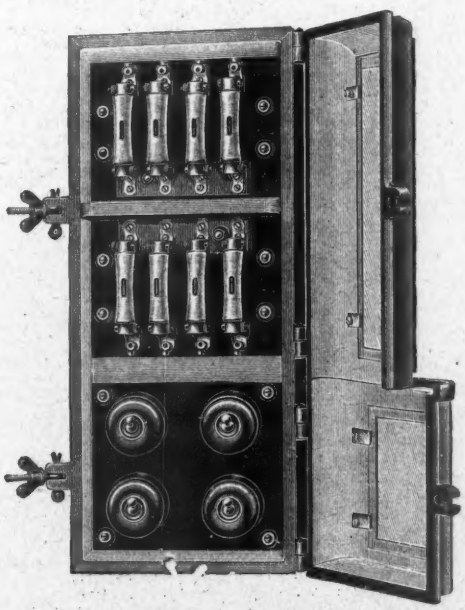


Fig. 2.—"Metallic" Ironclad Distributing Board.

switches, and is made for two to seven ways, 5 or 10 amperes. Other "Metallic" fuseboards are made in teak cases, with swing-back frames, which allow of ready access to the back of the board for wiring or inspection.

Solid (Keyless) Muff Coupling.

A new type of detachable coupling has just been introduced by Messrs. John Jardine, of Deering Street, Nottingham, and is shown in fig. 3. This coupling is turned bright all over, and has

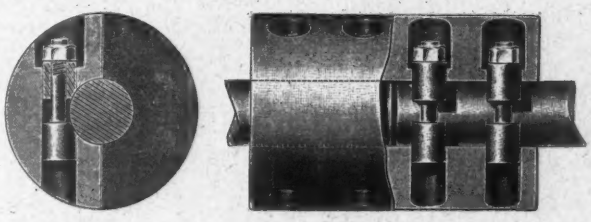


Fig. 3.—Solid Muff Coupling.

no projecting parts, being tightened on to the shaft ends by means of wedge bolts in recessed holes.

Keys and key-ways are not required, and for export purposes particularly, these couplings offer many advantages over the ordinary flange couplings.

Benjamin Reflector Fittings.

The Benjamin Electric, Ltd., of 117, Victoria Street, S.W., are supplying their patent reflector fittings in two types, giving either concentrated or distributed illumination, and suitable for metal-filament lamps of 50 to 1,000 watts; each reflector is designed for a single lamp which needs no outer globe, as the fittings are

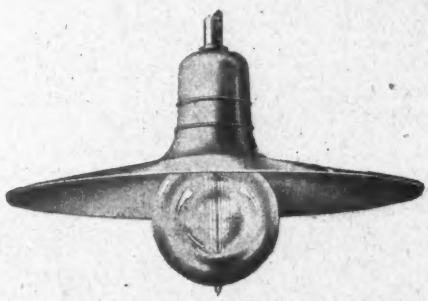


Fig. 4.—Benjamin Distributing Reflector Fitting.

weatherproof. They are made for outdoor or indoor use, and consist of vitreous enamelled steel. The "Benco" shockproof lamp-holder, consisting of two pieces of vitreous porcelain, with all conducting parts completely enclosed, is used in all the fittings. We illustrate the distributing type, which, with other matters, is described in Section List No. 44, just issued.

The I.M.E.A. Convention.—The annual meeting of the Municipal Electrical Association takes place this year at Harrogate, on June 18th, 19th, 20th and 21st inclusive.

Following the civic welcome in the Kursaal on the first day come the presidential address by Mr. George Wilkinson, the borough electrical engineer, and a discussion on "Means for Securing Reliability and Maintaining Continuity of Electricity Supply," introduced by Mr. Frank Ayton, Ipswich. In the afternoon similar discussions on "A Cooking Load from the Supply Station Point of View," introduced by Mr. F. M. Long, Norwich, and "Electrical Cooking Apparatus," introduced by Mr. H. H. Holmes, Marylebone, will take place, this time at the Hotel Majestic, which, we may add, is the headquarters of the Association during its stay. In the evening a reception takes place by the Mayor and Mayoress of Harrogate, followed by a special concert in the Kursaal.

The second day's proceedings take place in Leeds, which will be reached by special train, and include in the morning, at the Albert Hall, the discussion of papers on "The Limitation of Rate Relief from Profits," by Mr. S. L. Pearce, Manchester, and on "Organisation in Electrical Supply Undertakings," by Mr. C. M. Shaw, Worcester, and in the afternoon visits to the Corporation power stations, &c. Later in the evening, the annual dinner takes place at the Hotel Majestic. The third day is given up to visiting Middlesbrough, a special train being provided. The morning will be occupied with discussion on "Automatic Pressure Regulation," a subject to be introduced by Mr. S. J. Watson, Bury, while visits to the works of Messrs. Samuelson, Messrs. Dorman, Long & Co., and the Cargo Fleet Iron Co., a trip on the Tees and an inspection of the local transporter bridge, should more than occupy the remaining daylight hours. An alternative, and much less strenuous, visit is also provided to York, on this day, principally for the benefit of the ladies of the party.

The last day of the Conference is, as usual, given over to the annual general meeting in the morning, and to what should prove—weather permitting—a delightful trip by road to Ripon, Studley Royal and Fountains Abbey, in the afternoon.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AMENDMENTS.

HOLLAND.—The Dutch Customs Authorities have decided that ignition dynamos or magnetos for explosion motors, imported separately are to be dutiable as instruments at the rate of 5 per cent. *ad valorem*.

BULGARIA.—A treaty has recently been entered into between the Governments of Bulgaria and Austria-Hungary, by which the duties on certain Austrian goods entering Bulgaria are to be reduced. As a result of most-favoured-nation treaties these rates will also be applicable to British goods. The following are the reductions on goods of interest to readers of the ELECTRICAL REVIEW :—

	Old rate. Francs per 100 kg.	New rate.
Bowls for lamps, of glass, with metal burners and reflectors, vases and other articles of hollow glass, with ground edges or with single-etched rings	50	30
Lamp glasses, ordinary or crystal bearing marks or not	20	15
Articles of aluminium, nickel, German silver and other metal alloys, even combined with other common materials	300	250

The above duties will come into force as soon as the treaty is ratified.

RUSSIA.—A Bill has recently been introduced into the Russian Duma, which proposes to increase the duties on incandescent electric lamps with metallic filaments to 65 roubles per poud (3s. 9½d. per lb.) if mounted, and to 90 roubles per poud (5s. 3d. per lb.) if unmounted. The duties at present levied under Sec. 169 (3) of the Russian Customs Tariff on incandescent electric lamps (30 roubles per poud if mounted, and 60 roubles if without mounting) are to be retained in the case of incandescent electric lamps with carbon filaments.

FRANCE.—The French Customs authorities have decided that articles formed of a combination of asbestos and india-rubber are to be dutiable as "other manufactures of india-rubber" or as "manufactures of asbestos," according to kind, whichever classification yields the higher rate of duty. Thus paper, pasteboard, threads and cords of asbestos combined with india-rubber are to pay 70 fr. per 100 kg. as "other manufactures of india-rubber"; whilst plaits, tissues and other wares composed of the same materials are to be dutiable under paragraph 4 of Tariff No. 620 *bis* at the rate of 75 fr. per 100 kg. India-rubber representing not more than 5 per cent. of the total weight of the articles is, however, to be left out of account for the purpose of tariff classification.

AUSTRALIAN COMMONWEALTH.—The Customs Authorities have issued the following decisions as to the duties to be levied on certain imported goods :

Slide rails, adjustable foundations accompanying small motor engines	25 % ad val.
Slide rails imported with dynamos	20% or 12½%, according to the power of the dynamo
Machinery or engine couplings	20 % ad val.
Ferodo bonded asbestos (containing wire)	Free

With regard to the certificate (form A) required to be produced for the entry of goods under the British Preferential Tariff, it has been decided that the ordinary signatures of declarants and witnesses are sufficient at the foot of the certificate, the full name of the declarant being shown at the head of the form.

NOTE.—The duties quoted above are in all cases those leviable under the British Preferential Tariff.

The Australian Customs authorities have issued a notice providing that parts of any article, machine or appliance shall, although specifically or generically provided for in the tariff as parts, if imported with any such article in a complete or substantially complete state, be classifiable under the tariff heading applicable to such article. Articles shipped in an unassembled condition ready, or practically ready, for assembling, shall be treated as though actually assembled.

NORWAY.—Notification has been received at the Foreign Office to the effect that, until further notice, circuit breakers, lampholders and plug sockets, are not liable to customs duty on importation into Norway. This exemption is granted by virtue of the provisions of the note to paragraph 393 of the Norwegian Tariff, which empowers the Customs Department to admit free of duty, under certain conditions, machines and apparatus of a kind not manufactured in Norway.

Colombia.—The municipal authorities of the town of Santo Domingo have leased a concession to a group of capitalists for the erection and exploitation of a power station and electric lighting plant in that town.

NEW PATENTS APPLIED FOR, 1912.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

10,685. "Electrical radiators and the like." C. R. BELLING. May 6th.

10,701. "Means for establishing electrical communication between ships and other vessels and the shore." A. G. POSSOLO. May 6th.

10,704. "Switches." H. G. C. FAIRWEATHER. (Hart Mnfg. Co., United States.) May 6th. (Complete.)

10,737. "Arc lamps." C. WEBER. May 6th. (Convention date, May 5th, 1911, Germany.) (Complete.)

10,749. "Means for electrically transmitting and receiving messages." A. T. M. JOHNSON, F. H. VARLEY, W. F. C. MICHAELIS, J. POWER and JOHNSON SECRET WIRELESS TELEGRAPH AND TELEPHONE TESTING SYNDICATE, LTD. May 6th.

10,758. "Shade carrier and locking device for electric lamps and holders." J. N. MOLLETT and E. E. EDWARDS. May 6th.

10,765. "Electric heating elements." ELECTRIC AND ORDNANCE ACCESSORIES Co., LTD, J. D. MORRISON and L. H. DAVIES. May 7th.

10,766. "Corrugated secondary battery box." E. J. CLARK. May 7th.

10,784. "Electric dynamos and motors." W. D. BELL. May 7th.

10,791. "Electric light fitting for sewing machines and machines of a similar nature." A. F. FRANCIS. May 7th.

10,802. "Electric locking apparatus." W. MITCHELL. May 7th.

10,805. "Supporting insulators for electric conductors." E. C. R. MARKS. (H. Reinert and K. Pettersen, Norway.) May 7th. (Complete.)

10,838. "Switches." H. G. C. FAIRWEATHER. (Hart Manufacturing Co., United States.) May 7th. (Complete.)

10,860. "Apparatus for tilting the shade of a pendant electric lamp." L. C. INGRAM and C. E. HUNT. May 7th.

10,861. "Sparking plug." L. C. INGRAM and C. E. HUNT. May 7th.

10,863. "Transmission of electric energy at a distance without connecting wires and a new system of wireless signalling." R. C. GALLETTI. May 7th. (Complete.)

10,869. "Trolleys for electric cars." S. J. VEACOCK. May 7th.

10,889. "Electric wire couplings or connections." D. BYROM. May 8th.

10,911. "Apparatus by means of which an electric circuit will be automatically closed at any particular telegraphic station by the reception there only of a specially arranged number of and sequence of telegraphic signals sent by wireless or other method and capable of working a relay." W. J. LYONS. May 8th.

10,927. "Form of electric fire-alarm apparatus." H. NEAL and E. E. MOORE. May 8th.

10,959. "Electric incandescent lamps and lampholders." J. STONE & Co., LTD., and A. C. T. MYERS. May 8th.

10,989. "Electric cables." METAL JOINTING Co., LTD., and T. HARDEN. May 8th.

10,994. "Sparking plugs." G. E. FORSTER. May 8th.

11,051. "Electric switches." A. H. F. PERL. May 9th.

11,079. "Electric arc welding." A. P. STROHMENGER. (Addition to 1,274, 1912.) May 9th.

11,085. "Hoisting and lowering ships' boats from the navigating bridge by electricity." J. GUTHRIE and T. ANGEL. May 9th.

11,091. "Apparatus for producing electric oscillations adapted for wireless communication and other purposes." W. DUBILIER. May 9th. (Complete.)

11,109. "Means for securing electrotypes and the like upon the cylinders of rotary printing machines." G. M. BROWN and J. MURRAY. May 10th.

11,126. "Electrical switches." J. H. WOOLLISCROFT and H. T. BOOTHROYD, LTD. May 10th.

11,155. "Electrical incandescent lamp-holders, ceiling roses, or like articles to which flexible conductors are connected." H. E. EVANS. May 10th.

11,175. "Apparatus for the control of electric circuits." H. LEITNER. May 10th.

11,240. "Mounting electric generators upon the head frame of windmills." A. P. TURNBULL. May 11th. (Complete.)

11,252. "Machines for forming filaments." BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co., United States.) May 11th.

11,259. "Apparatus for preventing the fraudulent use or theft of electrical energy." M. G. DIAZ and A. A. Y GRESILLON. (Addition to 14,259, of 1908.) May 11th.

11,260. "Electric circuit closing devices." NALDER BROS. & THOMPSON, LTD., and A. F. HARRIS. May 11th.

11,261. "Graded service automatic telephone system." H. BARON. (G. Heinmann, Germany.) May 11th. (Complete.)

11,271. "Process relating to galvanising in a cold state." E. BALLEGEER. May 11th. (Complete.)

11,272. "Wireless telegraphy and telephony." J. T. SIBLEY. May 11th.

11,279. "Electrical measuring apparatus." W. H. APTHORPE and CAMBRIDGE SCIENTIFIC INSTRUMENT Co., LTD. May 11th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1911.

ELECTRICALLY-OPERATED SIGNALS FOR RAILWAYS. Automatic Electric Block Signalling Co. and R. P. Brousson. 14,148. June 14th.

GAS CONTROLLERS, ELECTRIC TIME SWITCHES AND OTHER TIMING DEVICES. G. O. H. Hortsmann, E. H. Hortsmann, W. T. Edgar. 14,825. June 26th.

ELECTRIC ARC LAMPS. J. Wetter. (Ges. fur Maschinen und Metall-Industrie.) 17,778. August 4th.

ELECTRIC SPARKING APPARATUS FOR INTERNAL-COMBUSTION ENGINES. Unterberg and Helmle (Firm of). 21,785. October 3rd. (October 11th, 1910.)

TELEPHONIC APPARATUS. E. A. Graham. 22,558. October 12th.

PERFORATING APPARATUS FOR TELEGRAPHIC STRIPS. E. Belin. 25,157. November 11th. (Divided application on No. 9,556 of 1911. April 19th.)

MEANS FOR COOLING THE ROTOR OF ELECTRIC MACHINES, ESPECIALLY TURBO-GENERATORS. K. J. Korner. 26,756. November 29th. (January 4th, 1911.)

HOLDERS FOR ARTICLES TO BE TREATED BY ELECTRO-DEPOSITION. C. Boirre. 28,506. December 18th.

ELECTRIC MOTOR CONTROLLERS. T. Barnard and G. C. Edwards. 4,190. February 18th.

TELEGRAPH TRANSMITTERS. J. W. Mackenzie. (American Transmitter and Manufacturing Co.) 10,044. April 25th.